Proceedings of the New Zealand Grassland Association 49: 57-62 (7988)

PASTURE STRATEGIES FOR DAIRY BEEF PRODUCTION

G. P. Cosgrove and R. W. Brougham
Grasslands Division, DSIR, Palmerston North

Abstract

Improved pasture species, irrigation and nitrogen fertiliser options for increasing pasture growth rate during winter and Summer have been evaluated in growth rate and annual production of young Friesian bulls.

Effective increases in Summer pasture production have been obtained from the use of irrigation, Pawera red clover, Matua prairie grass and particularly a combination of irrigation and Matua. Nitrogen fertilizer, Matua and carryover effects of irrigation have increased cool season pasture growth rates. Liveweight gains reflect these increases except on Matua pastures where poor growth rate of calves occurs during summer. The negative effects of the different pasture treatments on spring liveweight gain are attributed partly to the effects of compensatory growth in bulls but also to treatment effects which reduce pasture growth rate during this season. For this reason the most effective gains are made by 15-18 month old bulls during summer.

Pasture species and pasture mixtures react differently to applications of irrigation and nitrogen fertilizer. The most appropriate Strategies and combinations are discussed.

INTRODUCTION

Management decisions in all animal production enterprises are greatly influenced by the seasonal nature of pasture production. For dairy beef production systems this means the timing of buying and selling decisions as availability of replacement animals is governed largely by the seasonal supply dairy industry. With buying and selling confined to limited periods for the purchase of weaners and the selling of finished bulls, management of the pasture component is important.

In Manawatu lowland growth rate of pasture can limit production by affecting liveweight gain in winter and the timing of slaughter in summer. This paper presents results from recent trials where strategies for increasing pasture and animal growth rate during both winter and summer have been evaluated.

EXPERIMENTAL

The trials reported here are part of a long term series of experiments looking at the effect of a range of factors on pasture and animal productivity. The trials are located at Grasslands Division, DSIR Aorangi experimental farm 15 km west of Palmerston North. Soils at the site are mainly Kairanga silt loam and sandy silt loam, recent fertile alluvial soils (Rijkse and Daly 1972).

All trials have been conducted within self contained 1.6 ha farmlets replicated twice. Each farmlet is stocked with Friesian bulls at 7.4/ha in a 3 month calf to 15-18 month bull system. Replacement calves enter the system in early November each year.

Management

Bulls are rotationally grazed year round and during the late spring and summer when 2 age classes of bulls are present (3-6 month calves and 15-18 month bulls) calves are grazed as leaders and bulls as followers. The key management variables are rotation lengths and time of slaughter of the older bulls. Rotation lengths vary seasonally with approximate lengths being; autumn 65-70 days, winter 50-60 days, spring 24-32 days and summer 35-40 days. Within these rotation lengths grazing duration varies from 2-10 days (2-5 days for trials involving Matua prairie grass). Time of slaughter is governed by pasture availability during December - March and as this declines bulls are progressively removed from farmlets and slaughtered.

Measurements

Pasture. Pasture production is assessed using 1.8 x 0.9 m grazing exclosure cages. Herbage under three cages in each of three paddocks per farmlet is cut to grazing height following grazing. Herbage from each cage is bulked, weighed and subsampled for determination of DM, herbage mass and botanical composition.

Animal. All bulls are weighed regularly after 12-14 hours fasting to obtain empty liveweights.

Trial design. Two sets of farmlets are laid out in randomized block format. Within each set 2 farmlets are permanently allocated as controls and 4 farmlets are used for pasture variables being assessed. Data presented have been obtained from 3 separate trials. 2SP, 1982-85; 3SP, 1982-85; 4SP, 1985-87.

Treatments

Pastures. 2 species (and controls) (2SP) — Old ryegrass white clover pasture. 3 species (3SP) — Nui — Pawera — Pitau mixture (sown April 1981). 4 species (4SP) — Nui — Matua — Pawera — Pitau mixture (sown March 1985).

Nitrogen. 100 kg N/ha applied as urea in a split dressing; 50 kg in April and 50 kg in July, applied over the whole farmlet.

Irrigation. Spray irrigation applied by travelling irrigator. Frequency of application determined by water budget to keep the soil moisture deficit less than 50 mm. For 1982/3 and 1983/4 25 mm per application and for 1984/5 50 mm per application. Summer and autumn rainfall and amounts of irrigation water applied are shown in Table 1.

RESULTS

Herbage production

Pasture species. The 3 species mixture (3SP) produced significantly more than the old pasture control (C) in both autumn and summer but a similar amount in winter and spring (Table 2). Higher production by the ryegrass component (Table 3a) and the additional production from the Pawera component (Table 3c) explain the autumn response. The summer response comes from the Pitau white clover which produced significantly more than the resident white clover in the control (Table 3b), and the Pawera. Significantly higher ryegrass production in 3SP during winter and spring compared with control was not reflected in the total herbage produced during these seasons.

The annual production of the 4 species mixture (4SP) was not significantly greater than C, although summer production was significantly greater (Table 2). The ryegrass production in 4SP during all seasons was significantly less than C but this was more than compensated by Pawera and Matua (Table 3c). White clover annual production in 4SP was significantly less than C in all seasons although this only reached significance in autumn.

Irrigation. Annual herbage production responses to irrigation were recorded in 2SP, 3SP and 4SP pastures, resulting from increases during autumn and summer (Table 2). In 3SP Nui ryegrass production increased during autumn and summer to give a significant annual increase (Table 3a). In 2SP, the resident ryegrass responded to irrigation although the difference was significant during autumn only. In these pastures, an annual irrigation response in white clover resulted from a significant increase during summer (Table 3b) however neither the Pawera nor Pitau in 3SP and 4SP responded to irrigation. In 4SP the Matua component responded significantly to irrigation during summer and this resulted in significantly higher total herbage during summer.

Nitrogen. On an annual basis in the 4SP treatment nitrogen and irrigation effects are confounded. In spring, increased total herbage (Table 2) and increased Matua production (Table 3c), resulted from nitrogen fertilizer application. Ryegrass and clover production were unaffected by nitrogen fertilizer.

Liveweight gain

Species. Significant increases in annual liveweight gain on 3SP resulted from responses in autumn (7-9 months old), and in the summer prior to slaughter (Table 4) although a depression in liveweight gain during spring was recorded on 3SP. On 4SP pastures annual liveweight gain was not significantly different from the control, because increases in liveweight gain during winter ($P<0.05$) and summer (bulls, $P<0.01$) were

Table 1: Summer and autumn rainfall and irrigation quantities (mm) applied during the trial period.

	Summer	Autumn	Total	irrigation
1982/3	245	134	379	250
1983/4	146	212	357	250
1984/5	335	136	473	250
1986/7	143	254	397	200
15yrmean	163	174	357	—

Table 2: Seasonal herbage production of 3 pasture types and responses to nitrogen and irrigation treatments.

	2 species			3 species			4 species		
	Control		Irrig	Control	3SP	3SP+I	Control	4SP	4SP+I+N
Autumn	2017	**	2566	1757	226a	2913	2706	3362	3834
Winter	2267	(*)	2480	1509	1796	1095	2323	1967	1961
Spring	5589	n.s.	5618	4914	4529	4764	4547	3907	4769
Summer	5761	**	6166	5060	5623	6281	3267	4400	6231
L.S.O.					512’			939	
Annual	15634	**	16672	13260	14216	15853	12643	13656	16615
L.S.O.					1024			2650	($P<0.01$)

(*), *, ** means significantly different at $P<0.1$, $P<0.05$, $P<0.01$.
‘Within season only, L.S.O. $P<0.05$ unless otherwise stated.
n.s. Means not significantly different.

Table 3. Seasonal pasture component production of 3 pasture types and response to nitrogen and irrigation treatments.

kg DM/ha

	2 species			3 species			4 species		
	Control		Irrig (I)	Control	3SP	3SP+I	Control	4SP	4SP+I+N
(a) Ryegrass									
Autumn	1203	**	1745	736	1161	1574	996	265	321
Winter	1736	n.s.	1955	876	1409	1444	1261	340	257
Spring	4076	n.s.	4317	2501	2963	3174	2566	1136	1071
Summer	3658	n.s.	3750	1069	2053	2560	1227	362	746
LSD.					463			759	
Annual	10675	**	11767	6002	7606	6772	6072	2103	2395
L.S.D.					924			1517	
(b) White Clover									
Autumn	356	n.s.	419	261	182	290	421	137	132
Winter	161	n.s.	175	160	126	114	357	138	t3
Spring	659	n.s.	464	737	472	546	577	367	236
Summer	855	**	1337	710	1102	1376	409	305	553
L.S.D.					223			335	
Annual	2051	*	2414	1868	1664	2328	1764	947	964
L.S.O.					669			446	

(c) Matua and Red clover

	Red clover		Matua		
	3 species†	4 species†	4 species		4SP + I+N
Autumn	566	237	2470		2880
Winter	77	117	1167		1360
Spring	404	612	1532	(*)	2462
Summer	1270	1236	2073	.	3276
Annual	2323	2202	7242	*	10000

† mean of non-irrigated and irrigated treatment
treatment effects non significant

negated by lower liveweight gain of calves during summer and 12-15 month old bulls during spring.

Irrigation. Irrigation responses were influenced by pasture treatment. Largest responses were obtained on 2SP pastures with a significant annual increase in liveweight gain and increases during summer in both calves and bulls. A small reduction in LWG during spring, as a result of irrigation was significant at the 10% level. In contrast no annual response occurred on 3SP although liveweight gains were higher during autumn and summer (bulls) but lower during spring. On 4SP an increase in LWG of bulls occurred during summer. However, the combined response to nitrogen and irrigation was not significant on an annual basis.

Nitrogen. A small (significant $P<0.1$) response in liveweight gain to nitrogen fertilizer occurred during winter on 4SP pastures (Table 4).

Table 4: Seasonal liveweight gain of 3-16 month old bulls on 3 pasture types and responses to nitrogen and irrigation treatments.

	kg liveweight gain/ha								
	2 species			3 species			4 species††		
	Control		Irrig	Control	3SP	3SP+I	Control	4SP	4SP+I+N
Summer	550	*	634	575	577	570	509	419	410
Autumn	263	(*)	330	156	261	316	433	433	419
Winter	162	n.s.	177	17	66	111	-26	69	139
Spring	666	n.s.	837	691	636	748	691	561	576
Summer	327	(*)	362	307	398	457	224	266	355
L.S.D.					65			77	
					54	(P<0.1)		62	(P<0.1)
Annual	2187		2361	1946	2138	2203	1829	1771	1898
L.S.D.					145			172	

†† 1 year's data.

DISCUSSION

Increases in pasture and animal production from using improved pasture cultivars in 3 species and 4 species mixtures are attributable to seasonal growth peaks of individual species. In 3 species mixture the Pawera red clover is the major contributor to the increase in summer and autumn production. In addition Pitau and Nui produce more during summer and autumn respectively, than do the comparable resident species in the control pastures, reflecting the agronomic superiority of these newer cultivars (Brock 1974, Armstrong 1977). In 4 species mixture the Matua has a dominant influence on the high autumn production and in conjunction with the Pawera accounts for a large proportion of summer growth.

Despite increases in pasture growth during summer, autumn and winter, reduced spring growth occurs in both 3 species and 4 species mixtures and although not statistically significant, these reductions are reflected in lower spring liveweight gains. Pawera has a tendency to dominate summer production in a 3 species pasture but cause lower early spring growth becuase of a reduced ryegrass density (unpubl. data). The objective of including Matua was primarily to avoid this problem by increasing cool season grass content and hence growth rate. However the vigorous erect growth of Matua dominates the ryegrass in autumn in a similar way that the Pawera dominates a 3 species mixture in summer. As a result cool season production particularly during late winter and early spring shows no improvement over the ryegrass white clover control. It is possible to alter the seasonal distribution of production, though not total production, in a 3 species mixture through controlling Pawera growth in summer and achieving better cool season growth (Cosgrove & Brougham 1965). Matua is sensitive to grazing frequency (Cosgrove 1986) and reducing autumn dominance through more frequent grazing may promote ryegrass content and, therefore early spring growth. Although liveweight gain during winter is higher on the Matua mixture than on the control this superiority occurs during the early winter and through late winter liveweight gains reflect the pasture growth pattern.

Pasture responses to irrigation occur during both summer and autumn on all pasture types and even extend into winter on the old ryegrass white clover pastures. As irrigation was applied during the summer period only, autumn and winter gains represent a positive carry over effect. Species, cultivars within species and the mixtures they are used in determine the responses to irrigation. In old pastures summer and autumn responses come from the white clover and ryegrass components respectively, whereas in the 3 species mixture only the Nui ryegrass responds to irrigation, but during both summer and autumn. The lack of a response to irrigation from Pitau when the resident clover did respond may be related to the greater competitive effects induced by the irrigation responsive Nui (in 3SP) and Matua (in 4SP) and to the presence of red clover. Although Pawera did not respond to irrigation, its natural drought tolerance and erect summer growth make it very competitive to white clover in a mixture (Brougham 1965). In contrast to its response in 3SP, Nui does not respond to irrigation in 4SP when the growth of the more aggressive Matua totally dominates the ryegrass component during summer and autumn. Annually 4SP is the most responsive mixture to irrigation largely due to Matua growth during summer. Part of the annual herbage production response of this treatment comes from the nitrogen fertilizer and this also is attributable to the Matua component. The extra 1300 kg DM/ha from Matua during the cool season gives a response efficiency of 13 kg DM/kg N applied and compares with previously recorded responses of 6-10 kg DM/kg N on similarly managed ryegrass white clover pasture at the same site (unpubl. data).

Liveweight gain responses to irrigation are more difficult to explain. Seasonal responses occur on each pasture type although there is no annual response on 3SP. For 15-l 8 month old bulls in their second summer irrigation increases LWG on all pasture types but for 3-6 month calves a summer LWG response occurs only on 2SP. This is related to clover contents and clover responses to irrigation in 2SP and 3SP pastures. During summer calves on both pastures grazed as leaders ahead of the bulls and had an unrestricted intake, however the overall lower clover contents of 2SP but the increase with irrigation is reflected in liveweight gains. Where clover contents were higher on 3SP pastures but not responsive to irrigation, calf LWG's showed no irrigation response either. In addition there is a large negative irrigation effect on LWG on 3SP pastures during spring. Compensatory growth in bulls on unirrigated pastures after poorer autumn and winter LWG is apparent as herbage production during spring is similar on both irrigated and unirrigated 3SP pastures. This effect of compensatory growth also occurs on 4SP pastures. The addition of nitrogen fertilizer increased spring herbage production, however, spring LWG was similar on both 4SP pastures, after poorer winter LWG on the non irrigated, non fertilized treatment.

The high annual herbage production of 4SP with nitrogen and irrigation is only poorly reflected in annual liveweight gain. Despite ad libitum feeding of calves during summer, their LWG during this period is lower on both 4SP pastures than on the ryegrass-white clover control. Although white clover contents in 4SP are low, total clover contents (red and white) are higher than the control and are unlikely to be implicated in poor summer weight gains. The reduced feeding efficiency on 4SP (kg feed eaten/kg LWG) is confined to the summer period and is most detrimental to calves. However, the greatly increased herbage production on these pastures more than compensates for this effect and, by enabling a higher stock carrying capacity, higher total LWG in bulls during summer is possible. Nonetheless, further work is required to elucidate the causes of poor calf LWG in summer.

PRACTICAL IMPLICATIONS

1. Several strategies can be used to increase the liveweight gain of young dairy beef bulls during summer, autumn and winter but the most effective gains with summer active pasture species and irrigation are made by 15-18 month bulls during summer prior to slaughter. Advantages in liveweight achieved during the summer, autumn or winter in bulls less than 1 yr old are partly or wholly lost through spring. When spring herbage production is

unaffected by pasture treatment (e.g. irrigation on 2SP and 3SP) this is caused by the effects of compensatory gain, but is compounded by treatments which increase summer and autumn pasture growth at the expense of lowering spring growth rate (e.g. 3SP and 4SP). Higher liveweight gain of 15-18 month bulls is achieved through higher daily liveweight gain on 3SP and by enabling a higher carrying capacity on 4SP and with irrigation.

2. Different responses of pasture species and cultivars to nitrogen and irrigation should be considered when different strategies are compared. Matua is more responsive than ryegrass to both nitrogen fertilizer and irrigation and where these inputs are available use on Matua pastures will improve the efficiency of response. In contrast, red clover produced as much under dryland conditions as it did under irrigation and its use is particularly valuable when irrigation is not available.

3. Seasonal performance and responses of white clover and ryegrass are affected by the cultivar used and the pasture mixture. Newer cultivars of each species respond differently as pasture mixture complexity increases. White clover and ryegrass responses to irrigation diminish in more complex, competitive mixtures.

Acknowledgements

G.P. Owens, J.S. Cudby, R.G.C. Maxwell and W.J. Thomas for pasture and animal management, R.H. Fletcher for statistical advice and Y. Gray and stall of the Herbage Dissection Laboratory for pasture component dissections.

References

Armstrong C.S. 1977. 'Grasslands Nui' perennial ryegrass. *NZ Journal Experimental Agriculture 5:* 381-4.

Brock J.L. 1974. Effects of summer grazing management on the performance of 'Grasslands Huia' and 'Grasslands 4700 white clovers in pastures. *NZ Journal* of Experimental *Agriculture 2: 365-9.*

Brougham R.W. 1965. The effect of red clover on the leaf growth of white clover under long spelling during summer. NZ *Journal of Agricultural Research 8: 659-64.*

Cosgrove G.P. 1966. 'Grasslands Matua': will it put you in clover? Dairyfarming Annual 196-198.

Cosgrove G.P., Brougham R.W. 1985. Grazing management influences on seasonality and performance of ryegrass and red clover in a mixture. *Proceedings NZ Grassland Association 46:* 71-76.

Rijske W.C.. Daly B.K. 1972. Soils of Aorangi Experimental farm. Manawatu district, New Zealand. NZ Journal Agricultural Research *15*: 117.136.