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Tactical supplementation of beef finishing cattle

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ABSTRACT

The impact of high quality supplementary feeds on cattle growth rates was investigated in 2 experiments. The first experiment was conducted during late summer (8 weeks) and involved 5 treatments which were replicated twice: no supplement, 2 and 4 kg rolled maize grain/hd/d; and 2.3 and 4.6 kg DM/hd/d high quality pasture silage. The second experiment was conducted during late winter (8 weeks) and involved 3 treatments which were replicated twice: 0, 2 and 4 kg/hd/d rolled maize grain. Rising 2 year steers were used and all pre- and post-grazing pasture masses were similar between treatments within each experiment. During the summer experiment pasture quality was poor and steer liveweight gains for the 5 treatments were: -0.04, 0.44, 0.55, 0.29 and 0.36 kg/hd/d respectively. In contrast, pasture quality was high during the winter experiment and liveweight gains were: 0.93, 1.09 and 1.25 kg/hd/d respectively.

The combined results of this experimental series show a consistent liveweight gain response to supplementation of high quality feeds, under both low and high quality pasture conditions. A general response of 0.15-0.20 kg liveweight gain/kg DM grain can be expected. Given current grain prices in New Zealand, its use as a tactical supplement in beef finishing systems will be confined to overcoming variable forage supply and attaining supply contract premiums. Pasture silage is an alternative supplement for summer, but high quality is a pre-requisite.

Keywords: beef cattle; grain supplementation; silage supplementation; liveweight gain; pasture substitution.

INTRODUCTION

The increased use of beef supply contracts between producer and marketer has been advocated as a path for increased returns for farmers. This provides an assurance to marketers that they will be able to supply their contracts and therefore, the ability to negotiate higher prices. However, this process hinges on the beef farmer being able to enter contracts with the assurance that they can supply according to specifications, regardless of climate conditions.

The use of supplementary feeds to improve animal growth rates is an option for farmers, when cattle are behind targeted growth paths. Considerable research has been undertaken investigating supplementation of grain to cattle whilst grazing pasture (Griebenow et al., 1997), yet the relevance of this research to New Zealand beef finishing systems is unknown. The research reported in this paper is the continuation of a study into the use of high quality supplements to overcome constraints within beef finishing systems. The first part of this study was reported by Boom and Sheath (1998). These 2 latter experiments were conducted to test the repeatability of responses to supplementation of grain and to compare them with those possible from high quality pasture silage.

MATERIALS AND METHODS

Treatments

Two experiments studying the supplementary feeding of grain and pasture silage to finishing beef cattle were conducted during 1998 at Whatawhata Research Centre. The first experiment (summer) ran for 8 weeks from 20 January to 17 March and involved 5 supplementation treatments viz; no supplement, 2 or 4 kg/hd/d of rolled maize grain and 2.3 or 4.6 kg/hd/d of pasture silage. These treatments were replicated twice. The second experiment (winter) also ran for 8 weeks from 30 June to 25 August. Treatments were: 0, 2 and 4 kg grain supplement/hd/d, replicated twice.

Experimental management

One hundred steers (18 month old progeny of Simmental bull and Hereford x Friesian cow) were randomised into their treatments (n=10/treatment) 3 weeks before the start of the summer experiment. Sixty of these same steers were re-randomised as rising 2 year old into their winter treatments (n=10/treatment) 3 weeks before the start of the winter experiment.

The experiments were run on rolling hill country (5-25 degree slope). Similar paddocks were aggregated into sets based on slope and aspect. These paddock sets were then allocated the treatments simultaneously. During each experiment 16 paddocks were grazed by each steer group with paddock grazing durations averaging 3.5 days. Grazing was managed so that pre- and post-graze pasture masses did not differ between treatments. Where pasture substitution occurred, this resulted in smaller paddocks being provided to the supplemented treatments.

Feeding of supplements

Rolled maize grain was the principal component of the grain supplement (89% DM, 13.4 MJ ME/kgDM, 8.6% crude protein). To assist in the control of acidosis, virginiamycin and sodium bicarbonate were added at 40g/tonne and 10g/kg respectively. Limestone flour was also added at 10g/kg. To ensure the addition of the grain supplement did not cause a treatment difference due to differing protein levels, 10% of the grain ration was made up of heat treated soybean meal (91% DM, 13.3 MJ ME/kgDM, 50.3% crude protein) during the summer experiment only. Grain was fed in troughs with 0.6 m space/head.

Wrapped pasture silage was used for the silage supplementation treatments in the summer experiment (48% DM, 10.7 MJ ME/kgDM, 14.9% crude protein). The aim was that these treatments matched the grain treatments in the total amount of metabolisable energy supplemented. Each bale of silage was sampled prior to use for determination of ME and DM%. The amount of silage to be fed was then calculated. Over the experiment, these treatments were supplemented on average with 2.3 and 4.6 kg DM/hd/d of silage. Silage was fed on the ground adjacent to a fence line in order to minimise wastage.

In order to ensure acceptance and nutritional adjustment, steers were pre-conditioned to their supplement for 2 weeks prior to the commencement of the experiments. Grain supplementation began with 1 kg/hd/d and increased 0.5 kg every 2 days until full supplementation levels were reached. Silage was introduced at the equivalent energy level. To enhance acceptance, 100 ml/hd/d of molasses was added to the grain rations during the first introductory week.

Measurements

Pre- and post-graze pasture masses were measured for each grazing using a calibrated, visual estimation technique. Pre- and post-graze pasture samples were collected to ground level and dissected into green leaf, dead leaf and stem fractions. Undissected samples were analysed for energy and protein by NIRS (Ulyatt et al., 1995). Apparent herbage intakes were estimated by pasture disappearance calculations, plus growth. During the winter experiment, soil treading damage during grazing was assessed. Pasture disappearance due to treading was estimated (Sheath and Boom, 1997) and then used to adjust apparent herbage intakes.

Steers were weighed fortnightly (whilst shifting to new paddock) throughout the experiments. At the completion of the summer experiment when supplementation ceased, all steers were re-randomised into 5 grazing groups to assess any carry-over effects during a 90 day period. After the winter experiment, 10 steers from each treatment were slaughtered to assess treatment effects on carcass weights. The remaining steers were re-randomised into 5 grazing groups to assess carry-over compensation during a 65 day period and then slaughtered.

Observations of supplement consumption were made twice weekly during the introductory weeks and twice fortnightly during the experimental periods. These involved observing and recording which animals were consuming supplement at 1 minute intervals for 10 minutes immediately after supplement was offered.

RESULTS AND DISCUSSION

Pasture conditions

Pasture conditions and allowances for both experiments are described in Table 1. The pre-graze pasture energy and crude protein values during the summer experiment were low at 8.7 MJ ME/kg DM and 10.8% respectively. This was a result of dry weather conditions throughout the experiment. In contrast, pasture quality during the winter experiment was high with pre-graze pasture energy and protein levels of 11.3 MJ ME/kg DM and 21.6% respectively.

TABLE 1: Mean pasture mass (kg DM/ha), green leaf herbage fractions (%) and pasture allowance (kg DM/100kg Lwt/d) for the summer and winter experiments.

Supplement Treatment	Pre Graze Mass	Post Graze Mass	Pre Graze Green Leaf	Post Graze Green Leaf	Pasture Allowance
		Summer Experiment			
No Supplement	3465	1747	45.3	43.0	5.29
2 kg Grain	3340	1671	44.1	39.7	4.99
4 kg Grain	3364	1718	44.3	40.3	3.93
2.3 kg Silage	3324	1686	45.8	39.5	3.93
4.6 kg Silage	3299	1705	44.6	41.4	3.03
SED	139	65	1.7	2.3	0.34
		Winter Experiment			
No Supplement	2409	832	83.3	75.4	3.78
2 kg Grain	2452	860	80.9	77.4	3.36
4 kg Grain	2462	873	79.5	75.8	3.06
SED	28	34	2.3	1.6	0.04

Acceptance of supplement

Prior to the summer experiment, the steers had no exposure to either silage or grain. Initial acceptance was higher for silage than grain with 83% and 29% respectively of the steers consuming supplement during the first introductory week. By the second introductory week acceptance was 99% and 94% for silage and grain respectively. All steers receiving silage showed consistent interest in the supplement throughout the experiment. Of the 40 steers receiving grain, 2 steers consistently showed little interest. After 24 hours, all grain was completely consumed throughout the experiment, while the utilisation of silage was estimated at 99.8% and 96.7% for the 2.3 and 4.6 kg silage treatments, respectively. This silage utilisation is high relative to other studies which report between 5-50% trampling and soiling (Kaiser et al., 1996). High utilisation levels were most likely due to dry soil conditions and the placing of silage adjacent to the fence line where minimal trampling can occur.

Summer liveweight responses

During the summer experiment, steer growth rates for the no supplement treatment were below maintenance (Table 2). This was not surprising given the poor quality of the pasture that was offered. There were significant responses to grain supplementation and these were similar to the response levels reported by Boom and Sheath (1998) under similar summer pasture conditions.

Both the apparent herbage intakes and the liveweight responses within the pasture silage treatments were lower than the comparative grain treatments. Given that a similar amount of metabolisable energy was supplemented between the two supplement types, the lower liveweight gains within the silage treatments could be assumed to be a result of reduced pasture intakes.

Once supplementation ceased and steers were allowed to compensate for 90 days, only the no supplement treatment remained significantly different in liveweight relative to the other treatments. Compared to the silage treatments the grain treatments showed reduced growth rates during this carry over period. This may result from greater rumen adjustment occurring in the grain treatments.

Table 2: Apparent pasture and supplement intakes and live-weight responses in the summer and winter experiments.

Treatment	Pasture Intake Kg DM /hd/d	Supplement Consumed Kg DM /hd/d	End of Experiment Lwt (kg)	Experiment LWG (kg/d)	Carry-over Lwt (kg)	Carry-over LWG (kg/d)
			Summer Experiment			
No Supplement	10.8	N/A	401	-0.04	430	0.32
2 kg Grain	10.8	1.8	436	0.44	466	0.34
4 kg Grain	8.4	3.6	440	0.55	459	0.14
2.3 kg Silage	8.1	2.3	421	0.29	455	0.44
4.6 kg Silage	6.4	4.5	429	0.36	455	0.29
SED	0.80	N/A	3.3	0.06	5.1	0.05
			Winter Experiment			
No Supplement	8.4	N/A	498	0.93	572	0.91
2 kg Grain	7.6	1.8	513	1.09	580	0.91
4 kg Grain	6.9	3.6	524	1.25	587	0.84
SED	0.27	N/A	3.7	0.05	4.9	0.07

Winter liveweight responses

Liveweight gain was high at 0.93 kg/hd/d for the no supplement treatment within the winter experiment. This was despite the relatively low grazing residuals. Even under these high liveweight gain conditions, there still were significant responses to both grain supplementation treatments. The 4 kg grain treatment again showed lower growth rates during the 65 day carry-over period, although this difference was not significant. This inverse relationship between liveweight gain during supplementation and gain during the carry-over period was greater in previous experiments reported by Boom and Sheath (1998), and was also noted by Perry et al. (1976).

General liveweight response patterns

Table 3 provides a summary of the liveweight response per kg of supplement from these 2 experiments and those reported previously by the authors (Boom and Sheath, 1998). Although there were differences between experiments, the basic protocol and stock type used were similar and therefore, reasonably comparable. Throughout these experiments the liveweight gain increased as the level of supplementation increased. However, in 3 of the 4 experiments reported, the liveweight gain response per kg of grain supplement was significantly higher in the 2 kg than the 4 kg treatments.

TABLE 3: Live-weight gain responses (kg/kg DM supplement) to supplementation for experiments 1997 and 1998.

Supplementation Treatment	Summer 1997	Winter 1997	Summer 1998	Winter 1998
1 kg Grain	N/A	0.22	N/A	N/A
2 kg Grain	0.21	0.23	0.27	0.11
4 kg Grain	0.17	0.13	0.17	0.10
6 kg Grain	0.14	N/A	N/A	N/A
2.3 kg Silage	N/A	N/A	0.15	N/A
4.6 kg Silage	N/A	N/A	0.09	N/A
SED	0.017	0.026	0.018	0.027

Calculated substitution rates are somewhat variable (Table 4) and reflect the difficulty in determining apparent herbage intakes from pre- and post-graze pasture measurements. Nevertheless, a general picture emerges with grain having a substitution rate of 0.5 – 0.7 kg pasture DM/kg grain DM. Substitution rates for silage are higher and appear to be one-for-one with pasture.

TABLE 4: Pasture substitution rates (kg DM/kg DM Supplement) for supplementation experiments 1997 and 1998.

Supplementation Treatment	Summer 1997	Winter 1997	Summer 1998	Winter 1998
1 kg Grain	N/A	-0.21	N/A	N/A
2 kg Grain	0.84	0.38	0.00	0.63
4 kg Grain	0.76	0.54	0.69	0.53
6 kg Grain	0.79	N/A	N/A	N/A
2.3 kg Silage	N/A	N/A	1.16	N/A
4.6 kg Silage	N/A	N/A	0.98	N/A
SED	0.19	0.25	0.26	0.10

To avoid the potential confounding of animal selection and higher quality intake of herbage in the supplementation treatments, the experimental protocol demanded similar pre- and post-graze pasture levels across treatments in each experiment. In feeding systems where supplementation is allowed to reflect in higher post-grazing conditions, it is likely that substitution rates would be lower and liveweight responses to supplementation higher than those reported in these experiments.

Industry relevance

Poor late summer and early autumn feed quality is typical for much of New Zealand pastoral systems, especially within a hill country environment (Waghorn and Barry, 1987). In contrast to this time period, quantity of pasture is usually the major constraint during winter and early spring. These experiments show that liveweight responses to grain supplementation are reliable during both of these seasons. Furthermore, responses were most efficient at low supplementation levels (approx. 20% of total intake). The results from these experiments would suggest that the use of grain is best when cattle are close to finished, as much of the advantage can be lost due to liveweight compensation once supplementation ceases.

The economic viability of grain supplementation is most likely to confine its use to covering unpredictable variations in forage supply. For example, given the current cost of rolled maize grain at $300/tonne, a liveweight response of 0.21 kg/kg DM grain would translate to a direct cost of $1.62/kg LWG. This would not be viable under present beef supply prices. However, if a contract required the supply of cattle to a specified date and weight (>270 kg carcass), what would be the economic outcome if there was a premium of 15 c/kg carcass over and above a schedule price of $2.30, given it was predicted that there will be a 10 kg shortfall in carcass weight? The direct costs of feeding these cattle with a grain supplement to achieve targets would be $30/hd, while the extra return would be $63.50, i.e.: a margin of $33.50.

Clearly, the comparatively high cost of grain supplement is a constraint to its widespread use. High quality silage (>10.5 MJ ME/kg DM) is an alternative as a summer supplement. Silage costs are extremely variable, ranging from as low as 5 cents/kg DM for pit silage to up to 30 cents/kg DM for purchased wrapped silage. At a cost of 15 cents/kg DM and a response of 0.14 kg LWG/kg silage, the breakeven cost-price for feeding silage would be $1.07/kg LWG. Currently this is economically viable. Repeating the previous contract example, the cost of the extra 10 kg carcass weight being sought would be $19.81 for a return of $63.50, i.e.: a margin of $43.69. The practical challenge is to consistently access and/or manufacture grass silage of sufficient quality.

This research shows the responses that are possible for high quality supplement use within New Zealand beef finishing systems. These supplements can not only cover periods of poor performance, but also enhance where performance is good. Their economic use will occur mainly when they are used tactically within the context of beef supply contracts.

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