

Liveweight gain per head and per ha throughout the year of lambs grazing conventional pastures and those that switch from grass to clover

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Abstract

Intensive lamb finishing requires a consistent supply of high quality forage throughout the year to regularly finish lambs. Per head and per ha liveweight gain of weaned lambs was compared in 13 batches of lambs on replicated irrigated farmlets for 2.5 years from conventional mixed tetraploid perennial ryegrass-white clover pastures (Conv) and pastures that were pure white clover for spring and summer and switched to overdrilled Italian ryegrass for the winter (Switch). Seasonal differences in stocking rate (lambs/ha), liveweight gain per head and per ha were significant ($P < 0.05$). Average daily liveweight gain/ha was significantly higher (6.01 versus 5.66 kg/ha/day for Switch and Conv, respectively, but the total grazing days were slightly lower on the Switch farmlets resulting in similar annualised liveweight gain per ha (1 800 kg) and net carcass weight (800 kg/ha) on both pasture treatments. The farmlets apparently utilised 10 000 kg DM/ha/yr of the 16 000 kg DM accumulated. **Keywords:** lamb finishing, annual productivity, farmlets

Introduction

The increasing demand for heavier lambs on a more regular basis to supply the chilled export market has resulted in an increasing number of intensively managed, lowland lamb finishing properties. Intensive production requires a consistent supply of high quality forage throughout the year to regularly finish lambs. Perennial ryegrass-clover pastures often fail to deliver this due to limited winter growth and a low proportion of clover in the pasture at critical times. The proportion of clover in perennial pastures is typically between 10-20% (Hoglund *et al.* 1979) and this is too low to contribute substantially to the animals' nutrient intake. Pure legume pastures promote greater lamb liveweight gain than ryegrass (Fraser & Rowarth 1996; Speijers *et al.* 2004) largely attributable to their higher rate of intake, faster rate of degradation and higher total intake. However, total annual livestock production from legumes is limited by their short growing season (Hoglund *et al.* 1979). Alternative pasture management options that seasonally combine different pasture species may be required to deliver a more regular

pasture supply.

One possible opportunity for enhancing lamb production throughout the year may involve a system where annual ryegrass is direct-drilled into white clover in autumn each year. Switching from legume to annual ryegrass in autumn may enhance winter forage production and allow the grass to benefit from the soil nitrogen fixed by the clover during summer.

This paper reports the results of a comparison of continuous lamb finishing on two farmlets: a Switch pasture where annual ryegrass was direct-drilled into a white clover pasture each autumn and allowed to return to clover in spring, and a conventional perennial ryegrass-white clover pasture. The target was to grow batches of lambs on each pasture type from around 27 to 40 kg liveweight (17.0 kg carcass weight) in 8 weeks (an average liveweight gain of 230 g/day).

Methods

The farmlets

An area of 3.8 ha was subdivided into 4 blocks (3 of 1 ha and 1 of 0.8 ha). Half of each block was randomly allocated to a Switch pasture ('Apex' white clover, 3 kg/ha) or a conventional pasture (Conv, 'Bealey' NEA2 tetraploid ryegrass at 20 kg/ha and 'Apex' white clover at 3 kg/ha) totalling eight plots. The pastures were established in the spring of 2005 following spraying (glyphosate, 2 L/ha) and cultivation. Each of the eight plots was fenced with traditional or semi-permanent fences and supplied with stock water; they were divided into four by temporary electric fencing to provide for a rotational grazing system within each plot. Spray irrigation was applied (approximated 50 mm per application) when required. Switch pastures were overdrilled with annual ryegrass ('Andy' tetraploid ryegrass, 20 kg/ha) on 15 March 2006 and again on 12 March in 2007. Continued persistence of the annual ryegrass in late spring 2006 prompted chemical removal in November 2007 with glyphosate (1 L/ha at 360 a.i./L).

Lambs

Lambs were bought-in as required and varied between batches in breed, sex and initial average liveweight and within batches by sex and initial liveweight (average liveweight 27.9 kg, range per batch was 23.3 to 33.5

kg). Lambs were allocated by liveweight and sex to all eight plots. Lambs were usually weighed off pasture after about 4 weeks and always at the end of each batch (around 8 weeks). All lambs received a quarantine anthelmintic treatment (product dependent on farm policy) before being placed on the plots. Lambs were either shorn before their use or sold as woolly lambs at the end of the batch period with the exception of one batch (Merino lambs, batch 5) that were shorn during the period. At the end of each batch, lambs which had reached the target slaughter weight were slaughtered and mean carcass weight recorded. The mean carcass weight was divided by the final liveweight of these lambs to give a dressing out % for each batch of lambs. Total carcass weight gain of each group was taken as the total liveweight gain multiplied by the mean dressing out % of the lambs that were slaughtered.

Grazing management

Pasture growth rate and botanical composition were determined at the beginning of each grazing rotation (with exception of a missed sampling in February 2007) from 0.2 m² quadrat cut to 2 cm beneath exclusion cages. Cages were shifted to a new area following sampling, previously mown to a residual height of 2 cm. Sub-samples of known weight from the pre-grazing cuts were retained for botanical analysis. Samples were dried in a forced-air oven at 70°C for 48 h. Lambs were rotationally grazed with the stocking rate, duration of grazing and interval between grazing adjusted between and within batches for pasture growth rate and cover, assessed visually. No pasture was conserved but topping was employed when necessary to maintain pasture quality.

Statistical analysis

Data for each batch were grouped into season and farmlet type and a split-plot ANOVA was performed in Genstat (v 12) to determine the effect of farmlet type, season and their interaction.

Results

Table 1 The season and year distribution of all batches of lambs carried on the Switch and Conventional farmlets and the interval between batches.

Batch	1	2	3	4	5	6	7	8	9	10	11	12	13
Season	Sum	Aut	Aut	Win	Spr	Sum	Aut	Win	Win	Spr	Spr	Sum	Sum
Year	2005	2006	2006	2006	2006	2007	2007	2007	2007	2007	2007	2008	2008
Duration (days)	46	48	50	68	76	61	99	50	62	39	35	38	62
Interval (days)		5	29	8	0	0	21	9	1	7	0	19	7

The pasture type comparison farmlets ran for 800 days, representing 13 batches of lambs with an average period of 61 days made up of 53 days grazing (range 28 to 99 days) and an average interval of 8 days between batches (range 0 to 29 days), the equivalent of 5.3 batches/annum. The season and year distribution of the batches is shown in Table 1. Results are presented per lamb and per ha 'by season' and on an annual basis.

Pasture production and composition

Through the experimental period pasture growth rate did not differ significantly between the Switch and Conv pastures (Fig. 1) except ($P < 0.05$) in winter (June) 2006 due to slow establishment of the annual ryegrass. Total annualised DM production was estimated to be 16 250 and 15 960 kg DM/ha for Switch and Conv pastures, respectively.

Clover content (% of DM) was significantly greater in Switch than Conv throughout the majority of the experimental period (Fig. 2). The difference between treatments was less in spring 2006 as annual ryegrass dominated in the Switch farmlets (Fig. 2). Spraying of annual ryegrass in the Switch treatment in November 2007 resulted in renewed clover dominance (data not presented) in this treatment for batches 12 and 13 (Table 1). The proportion of ryegrass in the pastures was essentially the inverse of values in Fig. 2 as there were few weeds or other species present ($< 5\%$ of DM).

Per lamb

The mean liveweight of lambs coming onto, and leaving the farmlets was 27.9 (batch range, 23.0 to 33.5 kg) and 38.2 kg (batch range, 36.8 to 42.0 kg), respectively. There was no significant difference in the average liveweight of lambs leaving the Switch or Conv farmlets (Table 2) as a consequence of no overall difference in average liveweight gain (216 and 206 g/day for Switch and Conv, respectively) or in the average length of each period (Table 2).

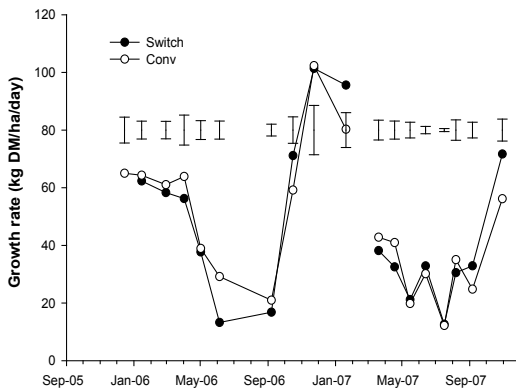
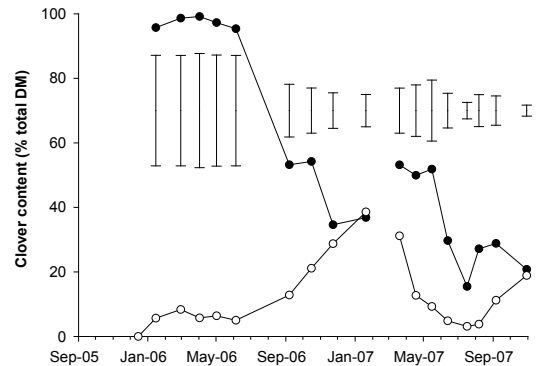
On both farmlets, liveweight gain was significantly higher in spring than in summer or winter, which in turn was significantly higher than autumn due entirely

Table 2 The average per head productivity of lambs on the Switch and Conv farmlets.

Trait	Pasture type	Season				Average
		Spring	Summer	Autumn	Winter	
Liveweight gain (g/day)	Both	251 ^a	202 ^b	176 ^c	218 ^b	211
	Switch	244	222 ^y	171	225	216
	Conv	257	182 ^z	180	211	206
Final liveweight (kg)	Switch	40.0	38.5	35.8	38.7	40.1
	Conv	40.2	37.1	36.7	39.3	39.1
% Slaughtered	Switch	73.7	86.7	72.2	71.9	77.2
	Conv	87.6	81.5	79.0	77.8	81.8
Carcass weight (kg)	Both	17.5 ^{ab}	16.6 ^{ab}	16.4 ^b	18.6 ^a	17.2
	Switch	17.9	16.8	16.7	19.0	17.4
	Conv	17.0	16.4	16.0	18.2	16.8
Dressing out %	Switch	43.5	42.6	43.2	45.3	43.3
	Conv	42.1	43.1	41.9	44.5	42.7

Values for season effects followed by letters **a** to **d** are significantly different ($P < 0.05$).

Values for pasture effects followed by letters **y** and **z** are significantly different ($P < 0.05$).

Figure 1 Seasonal growth rate of Switch and Conventional (Conv) pastures. Error bars are SEM.**Figure 2** Clover content (% of total DM) in Switch (closed symbols) and Conventional (open symbols) pastures. Error bars are SEM.

to one autumn batch (2007) where lambs grew slower due to overstocking. Summer was the only season in which lamb liveweight gain was significantly higher on the Switch farmlet. A similar proportion of lambs was slaughtered from both farmlets, but the slightly lighter average final liveweight of Switch lambs combined with a slightly higher dressing out % (43.3 and 42.7 % for Switch and Conv lambs, respectively), resulted in an average carcass weight advantage of 0.6 kg to lambs from the Switch farmlet (17.4 and 16.8 kg for Switch and Conv, respectively).

Per hectare

The average stocking rate, duration of batches and lamb liveweight gain/ha/day over all batches of lambs was similar for both farmlets (Table 3). The average stocking

rate was 29.2 lambs/ha although this varied significantly between seasons in line with pasture growth (Fig. 1). Although there was no difference in the overall average stocking rate of the two farmlets, the Switch carried more lambs in spring, less in summer and fewer in winter than the Conv farmlets. Grazing days per batch was significantly longer by around 10 days in autumn and winter but the only significant difference between the farmlets was in summer when lambs were on Conv farmlets for nearly a week longer, reflecting their lower liveweight gain during this period.

The significant seasonal effect on lamb liveweight gain per ha/day mirrored the seasonal effect on stocking rate. Liveweight gain /ha/day was significantly higher on the Switch farmlet in spring and summer but lower in autumn. Overall lamb liveweight gain/ha was

Table 3 The average stocking rate, grazing days per batch and liveweight gain/ha of lambs on the two farmlets.

Trait	Pasture		Season			Average
	type	Spring	Summer	Autumn	Winter	
Stocking rate (lambs/ha)	Both	32.9 b	36.9 a	30.8 c	13.5 d	29.2
	Switch	38.0 y	35.4 z	30.1	10.8 z	29.1
	Conv	27.8 z	38.6 y	31.6	16.3 y	29.3
Grazing days per batch	Both	50.0 c	51.6 c	65.6 a	59.8 b	56.4
	Switch	49.5	48.6 z	63.9	56.1	54.9
	Conv	50.5	54.5 y	67.3	59.8	57.9
Liveweight gain (kg/ha/day)	Both	8.05 a	7.16 b	4.71 c	2.97 d	5.83
	Switch	9.01 y	7.59 y	4.25 z	2.65	6.01 y
	Conv	7.09 z	6.74 z	5.16 y	3.29	5.66 z

Values for season effects followed by letters **a** to **d** are significantly different ($P < 0.05$)

Values for pasture effects followed by letters **y** and **z** are significantly different ($P < 0.05$)

Table 4 The annualised productivity of the two farmlets.

Trait	Pasture type	
	Switch	Conventional
Liveweight gain (kg/ha)	1830	1845
Carcass weight gain (kg/ha)	800	790
Grazing days per ha	8465	8975
DM apparently utilised (kg/ha)	10275	10015

significantly higher (6%) on the Switch farmlets. The lower average stocking rate and liveweight gain/ha/day for the Switch farmlet in winter reflects the fact that no lambs were carried on this farmlet for the first of the winter batches.

Per annum

The annualised per ha productivity of the two farmlets (Table 4) shows on average they produced 1 840 kg and nearly 800 kg of lamb liveweight and carcass weight/ha/yr, respectively. The apparent DM utilised per ha, of 10 000 kg DM/ha/yr was calculated from the metabolisable energy requirements of the lambs (Nicol & Brookes 2007) based on the average initial lamb liveweight, liveweight gain and days per batch.

The higher grazing days per ha on Conv farmlets reflects the greater average number of batches per year on the Conv farmlets. However, the slightly higher stocking rate and liveweight gain of Switch lambs counteracts the fewer number of batches so that the total liveweight gain, carcass weight gain and apparent DM utilised per ha was similar for both farmlets.

Discussion

The objective of achieving a continuous annual output of finished lambs by adding 12 kg liveweight over 8 weeks at 230 g/day was almost achieved in both farmlets (Tables 2 & 3). After allowing for a pasture establishment of 60 days and due to the short turnover time between batches there were on average 5.3 batches of lambs per year. Although the targets were almost met, 300 of the over 1 400 lambs (20%) failed to meet target weight for slaughter. These lambs did not return to the farmlets as members of the next batch. Given that these 'store' lambs at the end of a batch were heavier on average (33.1 kg) than the average initial weight (27.9 kg), had they been retained for the next batch it is likely that overall, a higher proportion of lambs would have reached target slaughter weight.

There are few published reports of the seasonal or annual productivity of intensive lamb finishing units to make comparisons with. Intensive bull beef production systems (Clark 1992) produced up to 920 kg net carcass weight/annum, slightly higher than the 800 kg net lamb carcass weight produced from these farmlets. Vartha & Fraser (1978) produced 488 kg lamb meat/ha/yr from lucerne-'Tama' ryegrass plots but these included breeding ewes. The current results may set a benchmark for intensive lamb finishing.

The overall mean liveweight gain of 215 g/day is not high compared with some other reported short-term, post-weaning lamb liveweight gains (Fraser *et al.* 2004; Fraser & Rowarth 1996; Speijers *et al.* 2004) but is at the upper end of the range published for a farm survey (Everest & Scales 1983). Inconsistency in the average liveweight gain reduced the overall average. For example, 36% of all plot average liveweight gains

were >250 g/day but 33% were <200 g/day. Inability to consistently maintain a high liveweight gain was due to setting too high a stocking rate for some plot/seasons, leading to overgrazing and low feed intake; use of lambs with a lower potential for growth in some batches i.e. Merino lambs were used in batch 5 to ensure juvenile teeth were still present at the end of the period to maintain 'lamb' status for the carcasses; and batch 7 when monitoring of the farmlets was compromised.

We estimate, based on the annual pasture production and apparent DM consumed by lambs, that around 63% of the available DM was utilised by the lambs. This is similar to that achieved with bulls at a low stocking rate (Clark 1992) but much lower than that achieved by bulls and dairy cows at a high stocking rate of closer to 90% (Clark 1992). Macdonald *et al.* (2001) estimated pasture utilisation from 63 to 81% with increasing stocking rate on dairy cow farmlets. We acknowledge that our estimate of pasture production from cage cuts may be greater than that achieved on the grazed area (Orr *et al.* 1988; McNaughton *et al.* 1996) and know from the amount of pasture topping that was done, particularly on the Conv farmlet, that utilisation was not as high as possible.

Switch versus conventional system

The objective of the Switch system was to utilise annual ryegrass to increase the overall stocking rate and winter and early spring productivity of a pure white clover pasture. This was achieved as evidenced by the similar total productivity and seasonal pattern of output of the two farmlets. However, except in summer, the advantage of higher lamb liveweight gain from the legume-based pasture was not obvious. This probably reflects that in winter and spring, ryegrass was the dominant component of the diet of lambs on the Switch farmlet (Fig. 2).

Both systems had their advantages and disadvantages. Although the overdrilling of annual ryegrass into the Switch pastures increased their total annual DM production, the date of establishment was critical to their winter contribution and its removal from the pasture in spring was critical in regaining clover dominance. Vartha & Fraser (1978) also commented on this aspect in their switch to and from lucerne and 'Tama' ryegrass. Mechanical topping of pastures to removed seedheads was required during late spring and summer to maintain pasture quality but this was much less of an issue with the Switch pastures.

Conclusions

Intensively managed lamb finishing farmlets produced lambs of a suitable export carcass weight (17.0 kg) throughout the year resulting in a high annual output of

lamb carcass weight per ha. There was little difference in the productivity of conventional ryegrass-white clover-based farmlet and one that annually switched from clover to annual ryegrass.

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