The value of supplementary feeding to pre-weaned and weaned lambs grazing Italian ryegrass

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Abstract

The variation in, and often the disappointingly poor weight gains and the inability of lambs to achieve desirable carcass grades on ryegrass pastures have long been a concern to researchers, extension officers, advisors and farmers. The objectives of this study were to investigate whether concentrate supplementation to lambs on Italian ryegrass (*Lolium multiflorum* cv Midmar) pastures would improve the performance of lambs, and what the optimum level of supplementation is to lambs on the pasture. The investigation extended over the pre- and post-weaning growth phases of lambs and was conducted during two consecutive seasons at the Cedara Research Station in the KwaZulu-Natal Mistbelt. The pre-weaning stocking rate applied, was 20 South African Mutton Merino ewes with lambs/ha and the following treatments were applied: Control: continuous grazing - no creep feed; forward creep grazing by the lambs in a rotational grazing system where the lambs were allowed to graze paddocks allocated to the ewes, plus the next paddock in their series of grazing paddocks; 100 g creep feed/lamb/day; 250 g creep feed/lamb/day and creep feed *ad libitum*. The post-weaning stocking rate applied, was 50 lambs/ha and treatments were: Control - no supplement; 250 g of supplement/lamb/day (only the second season); 500 g of supplement/lamb/day and supplement *ad libitum*. From 42 days of age to weaning, supplementation significantly improved the live weight gain of suckling lambs. Creep feed intake varied between 300 and 350 g/lamb/day. The average daily gain of the weaned lambs improved significantly with supplementation. No significant advantage in terms of growth was gained by supplementing the weaned lambs at levels of higher than 500 g/day.

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Introduction

The poor performance of lambs on annual Italian ryegrass (*Lolium multiflorum* cv Midmar) pastures, considering its nutritive value of *c*. 200 g crude protein (CP)/kg dry matter (DM) and 10 MJ metabolisable energy (ME)/kg DM (Dugmore, 1995), is a general complaint among sheep farmers in KwaZulu-Natal. This is supported by studies in the KwaZulu-Natal Midlands where poor average daily gains (ADG) of 92 ± 6.67 g/day have been recorded in lambs on ryegrass during the last month before weaning, compared to gains of 208 ± 8.38 g/day for the first 42 days of lactation (de Villiers *et al*., 1993). It was suggested that the ewe's milk can sustain a high ADG during early lactation, but that the rapid decline in milk yield after six weeks of lactation deprives the lamb grazing fresh grass of rumen undegradable protein (UDP) (Robinson, 1990). Thomson *et al.* (1982) regarded the low concentration of UDP in fresh grass as a major limitation in its nutritional value, which would restrict the performance of grazing ruminants, particularly growing and lactating ruminants. However, Joyce & Rattray (1970) considered the two main factors limiting the growth of unweaned lambs reared on cultivated pastures to be the inability of a lamb's rumen to utilise pasture and its relatively small rumen size when consuming such a high moisture diet.

A standard practice in the KwaZulu-Natal Midlands is to grow out lambs after weaning on ryegrass pastures, aiming at a target slaughter weight of *c.* 45 kg. Smith *et al.* (1986) using a "put and take" grazing procedure, achieved weight gains of between 150 and 200 g/day in weaned Döhne Merino lambs on irrigated Italian ryegrass, while Jaqusch *et al*. (1979) recorded ADG's of between 47 and 183 g/day in lambs on a ryegrass/clover pasture. De Villiers *et al.* (1995) reported a weight gain of 169 ± 4.99 g/day in weaned lambs when the pre-weaning stocking rate was 20 ewes with lambs/ha and 147 ± 5.26 g/day at a pre-weaning stocking rate of 36 ewes with lambs/ha.

Johnson & Light (1965) showed that lambs receiving a creep feed from four weeks of age, were on average 6.3 kg heavier at weaning than lambs on pasture only. Likewise, Light & Haugse (1965) reported that lambs receiving a creep feed were marketable 28 days earlier than lambs without the creep feed. The lamb's ability to increase herbage intake is affected by the degree of competition for herbage with the ewe

(Gibb & Treacher, 1978). Therefore, supplementation should reduce such competition between lamb and ewe. The problem of competition for grass between ewe and lamb would be exacerbated by the relatively high instantaneous grazing pressure due to the high concentration of animals under rotational grazing systems (Warner & Sharrow, 1984). On the other hand, an advantage of supplementation is that a pasture can be grazed down to a point suitable for proper pasture management without the risk of poor animal performance (Van Ryssen *et al*., 1976).

The wide variation in weight gains, the often disappointingly poor growth and consequently the inability of lambs to achieve desirable carcass grades on ryegrass pastures have been a concern to researchers, extension officers, advisors and farmers in the region. The objectives of this study were to establish whether the supplementation of concentrates to lambs on Italian ryegrass pastures could improve the performance of the lambs, and to determine the optimum intake of the concentrate supplement from a biological point of view.

Materials and Methods

The investigation covered the pre- and post-weaning growth phases of lambs and was conducted during two consecutive winter seasons at the Cedara Research Station in the KwaZulu-Natal Mistbelt. The altitude at Cedara is 1 075 m with an average annual rainfall of 885 ± 142 mm, predominantly during summer (October to March). Italian ryegrass (cv. Midmar) was established annually during February on a 3.5 ha bottomland (Katspruit soil form) at a seeding rate of 25 kg/ha and fertilized at the recommended level of 350 kg nitrogen (N)/ha/season. The trial was conducted during the dry winter months and the pasture was irrigated weekly at an application rate of approximately 25 mm.

During the pre-weaning stage a stocking rate of 20 South African Mutton Merino ewes with lambs/ha was applied. The treatments were: Control: continuous grazing - no creep feed; forward creep grazing by the lambs in a rotational grazing system in which lambs were allowed to graze paddocks allocated to the ewes plus the next paddock in their series of grazing paddocks; 100 g creep feed/lamb/day; 250 g creep feed/lamb/day and creep feed *ad libitum*. The grazing system applied for all pre- and post-weaning treatments, except the continuous grazing treatment, was an eight-camp rotational system with a fixed period of stay of 3.5 days per camp. This allowed for a 24.5-day re-growth period. The rotational grazing area was divided into eight blocks. Each block was divided into three camps and randomly allocated to each of the three creep feed treatments. The ewes with lambs were allocated to the treatments using a randomised block design, blocking for body weight, birth status (singles and twins), age and sex. The lambs were weaned at an average of 100 days of age. Creep feed (without a cocciodiostat) was made available on a daily basis from approximately two weeks *post partum.* Faecal worm egg and oocyst counts were conducted on a weekly basis by Allerton Veterinary Laboratories. Strategic internal parasite control was based on the faecal egg counts.

The sheep had free access to fresh water in portable water troughs connected to a permanent water supply, and a mineral lick consisting of 34% salt, 33% bone meal and 33% feed lime. The same concentrate mixture was used as both the creep feed and the supplement for the weaned lambs, and consisted of 68% maize meal, 15% lucerne meal, 10% molasses powder, 5% of a commercial high protein concentrate (HPC; 380 g CP/kg; urea free), 1% feed lime and 1% salt and had an estimated composition (DM basis) of 12.3 MJ ME/kg, 117 g CP/kg, 63 g crude fibre/kg, 9.7 g calcium (Ca)/kg and 3.4 g phosphorus (P)/kg. The concentrate intake per group was recorded daily. During both the pre- and post-weaning trials a trough space of approximately 20 cm was allowed per lamb to minimize competition for concentrates.

During both trials, pasture availability was measured with a pasture disc meter (Bransby & Tainton, 1977) and expressed in cm of disc meter height (disc height). The mean disc height before (initial) and after (residual) grazing was calculated from 25 readings per paddock.

The ram lambs remained on the ryegrass during the post-weaning phase of the trial. The stocking rate was 50 lambs/ha. A rotational grazing system, as applied in the pre-weaning phase, was applied for all treatments. The lambs were re-allocated to treatments according to weaning weight, in such a way that the lambs in each of the pre-weaning treatments were represented in each post-weaning treatment. The treatments were: Control - no supplement; 250 g of supplement/lamb/day (only the second season); 500 g of supplement/lamb/day; *ad lib.* supplement. The lambs had free access to fresh water in portable water troughs connected to a permanent water supply, and a mineral lick consisting of 34% salt, 33% feed lime and 33% of a commercial phosphate supplement containing 12% P. Upon reaching an average live weight of 35 kg per treatment, the carcase grades of the lambs were estimated every 14 days on the hoof. Once 80% of the lambs in a treatment classified A3, the lambs in that treatment were slaughtered at the Cato Ridge abattoir (In the South African meat classification system the A in the A3 grade represents lambs with no permanent incisors and the 3, a carcass with more than 8.6% but less than 11.6% subcutaneous fat, SAMMIC, 2002). When the ryegrass became in short supply at the end of a season the lambs in treatments that did not achieve the 80% A3 grading were sent to the abattoir. All lambs were shorn prior to despatch to the abattoir. Wool samples from the midrib area were taken from each fleece and analysed at the SA Fleece Testing Centre at Grootfontein for fibre diameter and clean yield.

Analysis of variance, using Statgraphics (1988), on the animal performance data was carried out to test the significance of differences between treatments. An exponential function was fitted to ADG (Y) and supplement intake (X) by using Genstat Fitcurve Direction (1993).

Results and Discussion

During both seasons, the pre-weaning ADG's of lambs over the grazing periods of 84 days as well as their weaning weights did not differ among treatments (Table 1). The ADG's of the lambs for the period 14 to 42 days did not vary significantly among treatments. This suggests that the ingestion of milk during the first 42 days of lactation was sufficient to supply in the nutrient needs of the lambs, including the control, (de Villiers *et al*., 1993).

Table 1 Number of ewes and lambs used, supplement consumed by lambs, average daily gain (ADG), weaning weight of lambs and pasture height of Italian ryegrass during two seasons

	Treatments				
	Control (no creep feed)	Forward creep	Amount supplemented (g/day)		
			100	250	*Ad lib.*
Season 1:					
Number of ewes	12	12	12	12	12
Number of lambs	12	15	15	15	15
Supplement consumed* (g/lamb/day)					
14 to 42 days	-	-	60	108	120
42 days to weaning	-	-	100	231	517
ADG (g/day)					
14 to 42 days	262 ± 14	249 ±8	243 ±24	233 ±15	258 ±13
42 days to weaning	196^{a} ± 9	$221^{a,b}$ ±12	$206^{a,b}$ ±13	240^{b} ±14	297^{c} ±14
Over 84 days	240 ±10	240 ±8	231 ±19	235 ±13	271 ±11
Weaning weight (kg)	23.4 ± 1.47	23.0 ±0.81	22.5 ±1.69	22.8 ±1.08	25.0 ±1.04
Ewe weight change (kg)	-4.7 ±0.85	-8.2 ±0.54	-6.8 ±1.40	-5.3 ±1.03	-7.7 ±1.91
Initial pasture height (cm)	3.2	4.7	5.1	5.4	5.1
Season 2:					
Number of ewes	12	11	9	11	12
Number of lambs	13	14	10	12	14
Supplement consumed* (g/lamb/day)					
14 to 42 days	-	-	77	134	140
42 days to weaning	-	-	100	250	489
ADG (g/day)					
14 to 42 days	226 ±19	239 ±16	222 ±26	190 ±12	207 ±17
42 days to weaning	198 ±10	243 ±12	228 ±32	243 ±15	257 ±20
Over 84 days	211 ±12	238 ±11	222 ±26	213 ±9	228 ±16
Weaning weight (kg)	23.1 ±1.38	25.2 ±1.18	25.4 ±2.61	23.7 ±0.78	25.2 ±1.65
Ewe weight change (kg)	4.5 ±1.24	8.5 ±1.85	4.8 ±2.45	7.0 ±1.12	5.1 ±1.65
Initial pasture height (cm)	6.3	12.3	14.1	13.5	14.1

[a – c] Values in the same row with different superscripts are significantly (P < 0.001) different.

* "as is" basis.

The ADG of lambs during Season 1 improved (P < 0.001) with increasing levels of supplement for the period from 42 days of age to weaning. A similar trend (P = 0.190) was recorded during Season 2. The lambs in the unsupplemented treatments showed continued good growth after peak lactation of their dams. This did not agree with the poor growth of lambs on ryegrass during the last weeks before weaning, as observed by De Villiers *et al.* (1993). Not withstanding the good growth rates of the supplemented lambs from 42 days to weaning compared to the unsupplemented treatments, weaning weights among treatments did not differ significantly (Table 1). Lamb growth from 42 days to weaning (Table 1) in the forward creep grazing system did not differ from that of the lambs in the Control. When comparing creep grazing with set stocking densities, Conway (1968) recorded significantly better growth in lambs on the creep grazing only in one of five years. It could be speculated that a forward creeping system should be more advantageous at higher stocking rates than the present, since the lambs then would have unrestricted access to high quality grazing. However, such a system would be at the cost of ewe performance. The difference in average pre-grazing pasture heights over the two seasons (Table 1) indicates a difference in pasture availability between the two seasons. The lower pasture availability during Season 1 is reflected in the 7 to 12.5% weight loss of the ewes over the trial period, while during Season 2 they gained 9 to 17%. Despite the weight loss of the ewes during Season 1, their lambs maintained growth rates similar to those of the lambs receiving the supplements. This confirmed the ability of ewes to sacrifice their own body tissues when under nutritional stress in favour of milk synthesis to sustain the growth of their lambs (Williams *et al*., 1976). Creep feeding of their lambs did not affect the weight changes of their dams (Table 1).

Creep feed intake was *c.* 15 g/lamb/day when offered to the lambs at an age of two weeks. That increased to *c.* 630 g/lamb/day during the last week before weaning (Table 2). The average concentrate intakes in the *ad lib.* creep feed treatments over the 84 days were 340 and 334 g/lamb/day during the two seasons respectively (Table 1). Creep feed intake increased consistently with time to *c.* 25 to 30 g/kg body weight (Table 2), after which it stayed relatively constant.

Table 2 Mean creep feed intake ("as is" basis) per day and concentrate intake relative to body weight of the pre-weaned lambs in the treatments where the supplement was offered *ad libitum*

Week of supplementation	Season 1			Season 2		
	Creep feed intake (g/lamb/day)	Lamb weight (kg)	Creep intake/ kg body weight (g)	Creep feed intake (g/lamb/day)	Lamb weight (kg)	Creep intake/ kg body weight (g)
3	55	10.2	5.4	19	8.4	2.2
4	75	11.4	6.6	100	12.9	7.8
5	158	13.2	11.9	188	13.8	13.7
6	193	15.7	12.3	255	15.4	16.5
7	275	16.5	16.7	286	17.2	16.6
8	374	18.5	20.2	431	18.9	22.8
9	657	21.5	30.5	535	20.9	25.6
10	622	24.4	25.5	602	22.6	26.6
11	658	25.0	26.3	591	24.0	24.6

Supplementation during both seasons improved (P < 0.001) the ADG's of the weaned lambs above those of the control groups (Table 3). The lambs in both the 500 g/lamb/day and *ad lib.* treatments were marketed during Seasons 1 and 2 respectively 35 and 28 days earlier than the unsupplemented lambs. Due to the relatively slow growth of the lambs in the control during Season 2 their carcass weights were lower (P < 0.001) than those of the supplemented lambs. Pre-weaning treatment was found to have no effect on post-weaning gain, contrary to the findings of de Villiers *et al.* (1995). There were no significant differences in carcass weight among the treatments for Season 1. The variation in lamb performance and post-weaning growth between years is clearly illustrated by the difference in ADG's of 132 and 42 g/day of the weaned lambs in the control treatments in Seasons 1 and 2 respectively. In contrast to ewes' pre-weaning performance it should be noted that the pasture was shorter in Season 1 than in Season 2 (Table 3).

The data illustrated in Figure 1 suggested that no significant response was achieved by supplementing a lambs at level of higher than 500 g/day. The non-linear relations for supplement intake (X) and ADG (Y) for the two seasons were:

Season 1: Y = 203.4 - 63.54e-0.00292xX

Season 2: Y = 239.3 - 198.4e-0.00292xX

($S_{y.x}$ = 32.9; R^2 = 72.5; n = 63; P < 0.01; both seasons)

Both seasons: $Y = 214.1 - 112.9e^{-0.00278x}X (S_{y.x} = 43.9; R^2 = 51.1; n = 63; P < 0.01)$.

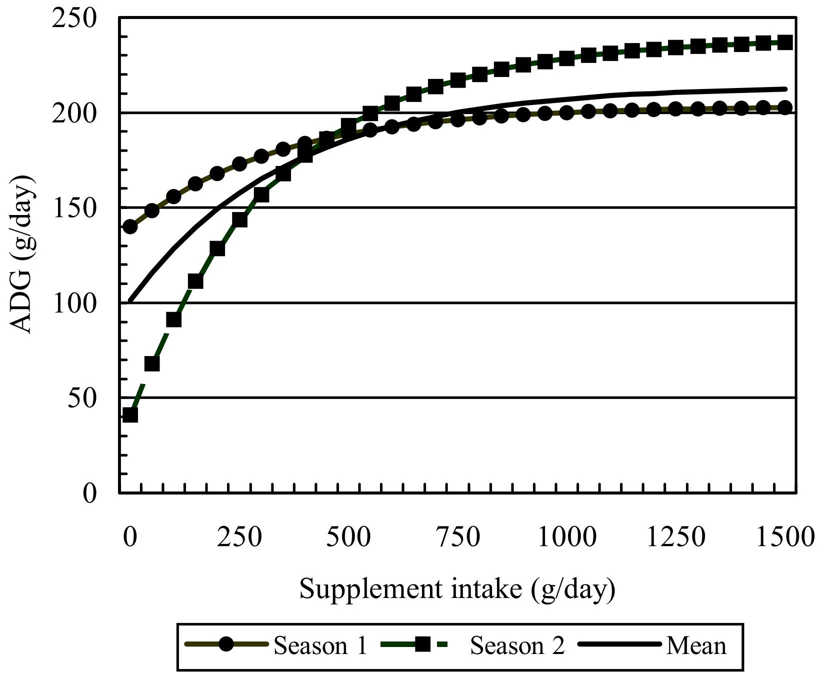

Figure 1 The relationship between supplement intake and average daily gain (ADG) of weaned lambs on ryegrass during Season 1, Season 2 and the mean of the two seasons

The curvilinear nature of the growth response curve to supplementary concentrate feeding determined in this trial is similar to the diminishing returns responses, determined for milk production in dairy cows on pastures fed different levels of concentrate (Dugmore *et al.*, 1997). The relationship between energy intake and milk yield in dairy cows is curvilinear (Blaxter, 1962; Dean *et al.*, 1972; Gordon, 1984) with the marginal milk response decreasing as the level of concentrate increases. These curvilinear responses could be attributed to changes in the substitution rate of roughages by concentrates. Faverdin *et al.* (1991) showed that the substitution of roughages by concentrates increases with increasing levels of concentrate feeding. Consequently, the additional gain in energy per increment of concentrate fed, decreased as the substitution rate increased, resulting in the curvilinear relationships measured. Analyses of pasture consumption, as measured by disc meter (Table 3) was 10% and 27% lower (per kg body weight) for the *ad lib*. treatment relative to the control, for Season 1 and 2 respectively. This suggests that substitution of roughage by concentrates occurred. The depression in intake was linearly related to the amount of supplement fed. Holmes (1975) showed that the substitution rate of roughages by concentrates increased as the digestibility of the roughage increased. This substitution effect increased from 35% in forage with a digestibility of 40% to a value exceeding 80% in highly digestible forages (*c*. 80% digestible DM). This increasing rate of substitution with increasing digestibility of forages resulted in diminishing animal production responses to concentrate as forage quality increases. These diminishing responses have been found in practice with dairy cows at Cedara. In dairy cows on kikuyu the milk production response per kg concentrate supplementation (*c*. 9.0 MJ ME/kg DM; Dugmore, 1998a) was 1.2 kg fat corrected milk (FCM) (Dugmore, 1998b) and on fescue, 0.88 kg FCM/kg concentrate (*c*. 9.4 MJ ME/kg DM; Dugmore *et al.,* 1992). Stockdale (1998) measured similar milk production responses to concentrate supplementation on herbages of differing energy concentrations. Marginal responses diminished linearly from 1.25 kg FCM/kg DM at a herbage ME of 8 MJ/kg DM to 0.3 kg FCM/kg concentrate DM at a ME of 12 MJ/kg herbage DM. These factors may explain some of the variation in the growth responses of the lambs to supplements during and between seasons. Similarly, in sheep Milne *et al*. (1981) recorded substitution rates of 61% on an organic matter basis on sward heights held at 2 cm and 87% on a less severely grazed sward maintained at 3 cm. Milne *et al*. (1981) also found that increasing rate of supplement depressed the organic matter digestibility of the herbage by 0.50 percentage units per 100 g supplemental organic matter when individually penned ewes were given four amounts of supplement and offered *ad lib*. freshly-cut perennial ryegrass herbage.

The economic response of supplementation will vary significantly from season-to-season depending on the reigning production costs of pasture, the cost of concentrates and market price of the lambs, all of which differ from season-to-season and farm-to-farm. In the present study concentrate intake levels exceeding 500 g/day were not profitable.

Clean wool yield among the treatments was not significantly different. During Season 2 supplementation increased ($P < 0.014$) the fibre diameter. The lambs gained on average 132 g/day during Season 1. It was, therefore, possible during some seasons to produce a slaughter lamb with a carcass weight of 19.8 kg and a carcass fat coverage of 1.8 mm on annual ryegrass without supplementation. However, it took approximately four months to produce a slaughter lamb without supplementation compared to three months and less for lambs supplemented at 500 g/day and *ad lib*.

Table 3 Supplement intake, average daily gain (ADG), pasture height, days to marketing and carcass weight of lambs post-weaning on Italian ryegrass with and without supplement

Parameter	Treatments			
	Control (no supplement)	Amount supplemented (g/day)		
		250	500	*Ad lib.*
Season 1:				
Number of lambs	13		14	13
Supplement intake* from weaning to marketing (g/lamb/day)	-	-	500	1519
Initial body weight (kg)	26.1 ±1.32	-	27.8 ±1.14	28.6 ±1.50
Final body weight (kg)	36.7 ±1.35	-	41.6 ±1.57	43.7 ±1.29
ADG (g/day) over 77 days	132^a ±11.20	-	169^b ±10.11	190^b ±4.53
Pasture height (cm)		-		
Initial	6.2	-	7.1	8.6
Residual	1.9	-	2.4	4.0
Difference (Pasture consumption)	4.3		4.7	4.6
Days to marketing	119		84	77
Carcass weight (kg)	19.8 ±0.809		21.5 ±0.739	21.8 ±0.975
Season 2:				
Number of lambs	8	6	5	5
Supplement intake* from weaning to marketing (g/lamb/day)	-	250	500	1011
Initial body weight (kg)	26.4 ±1.12	26.6 ±1.69	24.5 ±1.08	23.1 ±0.56
Final body weight (kg)	30.1 ±1.03	39.2 ±2.07	42.5 ±1.83	44.3 ±0.82
ADG (g/day) over 91 days	42^a ±15.22	146^b ±11.84	209^c ±15.73	247^c ±5.44
Pasture height (cm)				
Initial	15.6	15.1	16.1	17.8
Residual	5.2	4.9	5.7	6.6
Difference (Pasture consumption)	10.4	10.2	10.4	11.2
Days to marketing	119	105	91	91
Carcass weight (kg)	11.8^a ±0.45	18^b ±1.26	19.2^b ±0.86	20.0^b ±0.63

$^{a-c}$ Values in the same row with different superscripts are significantly ($P < 0.001$) different.
* "as is" basis.

Conclusion

In the present study, creep feeding had no significant effect on the weaning weights of lambs or on the performance of the ewes. However, post-weaning supplementation on ryegrass shortened the period from weaning to marketing by approximately one month, thereby reducing the risks of losses through theft, mortalities and health problems such as parasites and footrot. Creep feed intake measured in this study increased from *c.*15 g/lamb/day at introduction at 2 weeks of age to *c.*630 g/lamb/day, with an average of between 300 and 350 g/lamb/day over a period of 84 days to weaning. No significant advantage in weight gain was achieved by supplementing the weaned lambs on Italian ryegrass pastures at levels of higher than 500 g/day. However, supplementation offers a useful strategy to improve production when used strategically during periods of feed shortage.

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