The influence of stocking rate, growth implant, energy and ionophore supplementation on the performance of weaner wethers grazing irrigated Italian ryegrass (*Lolium multiflorum*)

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The performance of 98 Merino weaner lambs at two stocking rates (55 and 68 lambs/ha), with access to either no supplementation, 250 g molasses meal/lamb/day or 250 g molasses meal plus 35 mg ionophore (Lasalocid)/lamb/day, with or without a growth implant (zeranol) was examined on irrigated Italian ryegrass pasture. The lambs grazed the pasture from August to November for approximately 90 days, in a six camp rotational grazing system over two grazing seasons. Stocking rate, energy supplementation and the growth implants exerted a significant ($p \leq 0.05$) effect on livemass gain and the carcass grade achieved by the lambs over all treatments. The lambs at the light stocking rate gained 1 kg ($p \leq 0.05$) more than those at the heavy stocking rate. Lambs which received molasses meal gained 2.7 kg ($p \leq 0.01$) more than the unsupplemented lambs and 1.8 kg ($p \leq 0.05$) less than those which received molasses meal and the ionophore.

Die prestasie van gespeende Merinolammers op besproeide Italiaanse raaigras teen twee veebeladings (55 en 68 lammers/ha) met geen aanvulling, 250 g melassemeel/lam/dag of 250 g melassemeel plus 35 mg ionofoor/lam/dag, met of sonder 'n groeistimulant (zeranol) is ondersoek. Die lammers het die weiding vir ongeveer 90 dae tussen Augustus en November benut, in 'n ses-kamp wisselweistelsel oor twee seisoene. Veebelading, energie-aanvulling en die groeistimulant het 'n betekenisvolle ($p \leq 0.05$) effek op lewende massatoenames en die karkasgradering uitgeoefen. Lammers by die lae veebelading het 1 kg ($p \leq 0.05$) meer in massa oor die proefperiode toegeneem as dié by die hoë veebelading. Lammers wat die melassemeel ontvang het, het 2.7 kg ($p \leq 0.01$) meer in massa oor die proefperiode toegeneem as dié wat geen aanvulling ontvang het nie en 1.8 kg ($p \leq 0.05$) minder as die wat die melassemeel en die ionofoor ontvang het.

Keywords: Wethers, energy supplementation, ionophore, growth promotant, Italian ryegrass, stocking rate

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Introduction

Relatively poor lamb performance has been realized on irrigated ryegrass pastures (De Villiers *et al.*, 1993). The use of ionophores has been found to improve the efficiency of feed conversion and mass gain in livestock (Horton, 1984a), by increasing the ratio of propionic acid to acetic acid and butyric acid in the rumen (Schelling, 1984). Ionophores also increase the permeability of lipid

membranes to ions, especially potassium (K) and hydrogen (H) and to a lesser degree calcium (Ca) and sodium (Na) (Pressman, 1976). Subsequent trials have shown a decreased methane and lactic acid production, inhibition of protozoa and gram positive bacteria and a decreased rate of passage and rumen turn over when feeding ionophores (Schelling, 1984). These effects on the rumen have resulted in reduced feed consumption and improved protein utilization in animals (Horton, 1984b).

The response of sheep to ionophores in the feedlot situation is well established (Foreyt *et al.*, 1979), but the benefits of ionophores in lambs grazing a pasture such as irrigated Italian ryegrass with a relatively high crude protein (CP) and low dry matter (DM) content needs quantification, especially under local conditions. Furthermore, the additional effect of ionophores in controlling coccidiosis (Horton,1984b; Foreyt *et al.*, 1981), a major problem in sheep on irrigated pastures, has yet to be appreciated.

A hormone-free growth stimulant for ruminants known as zeranol is marketed under the trade name of 'Ralgro'. Sheep in feedlots implanted with zeranol exhibited improved growth and feed conversion rates and increased nitrogen retention in certain studies (Jordan & Hanke, 1969; Wilson *et al.*, 1972), but not in others (Grobbelaar *et al.*, 1975). Data to describe the response of grazing sheep to ionophores and the effect of zeranol on sheep performance are limited and do not exist for South African conditions.

The object of this experiment was to evaluate the effectiveness of an energy, energy and ionophore supplement and a growth implant on improving the performance of weaned lambs in an intensive pasture system.

Experimental procedure

The experiment was conducted at the Kokstad Research Station (30°31'S; 29° 25'E) which is situated in the Bioclimatic Group 4b (Phillips, 1973). The altitude at Kokstad is 1372 m and the average rainfall 800 mm.

During two consecutive years (1989 and 1990), 98 Merino weaner lambs per season, about 4 months old and at an initial mass of about 23 kg were randomly allocated to 12 treatments in six groups, according to a 2×3×2 factorial design, which is illustrated in Table 1. The design incorporated two stocking rates (55 and 68 lambs/ha). Since all treatments consisted of the same number of animals (8), the sizes of the treatment camps were adjusted to give the required stocking rate. The lambs received either no supplement, energy only or energy plus an ionophore. Half the lambs in each of the six groups were implanted with a growth promotant, zeranol (Ralgro), at the beginning of the trial and 45 days later (Table 1).

The weaner lambs were placed on Italian ryegrass (cv. Midmar) pasture during August 1989 and 1990 for a period of 90 days. The pasture was irrigated at a rate of 25 mm per week. It was fertilized at planting according to a soil analysis to achieve levels of 20 ppm phosphorous and 150 ppm potassium. Fifty kg of nitrogen (N), in the form of limestone ammonium nitrate (LAN), was applied per hectare of pasture at monthly intervals. A six-camp rotational grazing system, with a fixed period of stay of 3.5 days and a period of absence of 17.5 days was used. The desired intake of the supplement (250 g/lamb/day) was achieved after an adaptation period of two weeks. The supplement was fed fresh every morning and the intake was monitored.

Lamb mass gain was monitored by weighing the lambs on two consecutive days at the start (initial mass) and end (final mass) of the experiment, following the overnight withholding of pasture, supplement and water.

Composite faecal samples (one sample per group) were obtained from all the lambs at the beginning and then at monthly intervals until the end of the trial. Coccidiosis oocyst and roundworm egg counts were performed on these samples by the Allerton Veterinary Laboratory.

Table 1 The influence of energy, energy plus an ionophore and each with or without a growth promotant on the performance of lambs on Italian ryegrass (*Lolium multiflorum*) over two seasons (means ± SD)

Stocking rate (lambs/ ha)	Treatment	Molasses meal (g/ lamb/day)	Ionophore (mg/lamb/ day)	Growth promotant (mg/ lamb/45 days)	Mass gain per lamb (kg)	ADG (g/day)	Grades (%)		
							A3/A4	A1	A2
55 (Light)									
	1	0	0	0	6.2±3.6	68±24	0	19	81
	2	250	0	0	10.3 ± 2.8	114 ± 34	25	50	25
	3	250	35	0	11.4 ± 3.3	126 ± 35	38	19	43
	4	0	0	12	9.0 ± 4.3	100 ± 36	13	25	62
	5	250	0	12	11.5 ± 3.6	127 ± 38	13	56	31
	6	250	35	12	13.4 ± 3.1	148 ± 42	44	31	25
68 (Heavy)									
	7	0	0	0	7.0 ± 4.3	77 ± 47	6	13	81
	8	250	0	0	8.2 ± 3.0	91 ± 48	0	31	69
	9	250	35	0	10.6 ± 2.5	117 ± 36	19	44	37
	10	0	0	12	7.7 ± 4.5	85 ± 41	6	25	69
	11	250	0	12	10.2 ± 3.2	113 ± 39	13	37	50
	12	250	35	12	12.0 ± 4.1	133 ± 36	47	6	47

Treatments 2,3,4,5,6 > 1; 6 > 4; 9,11 >1,7,10; 12 > 1,4,7,10; ($p < 0.05$)

Rumen fluid samples (about 100 ml) were collected from two animals per treatment prior to the initiation of treatments (day 0), on day 45 and at the end of the trial on day 90, using the suction strainer technique described by Ruan & Burroughs (1962). These samples were assayed for ammonia (NH_3) according to the procedure described by Weatherburn (1967). Volatile fatty acids (VFA) were analysed by gas-liquid chromatography (Supelco Inc., 1975).

During both seasons composite herbage samples were obtained by combining six random samples each from an area 10×10 cm in size, cut at grazing height from one of the six camps allocated to each group, at the start (Aug.), on day 45 (mid Sept.) and at the termination of the trial (Nov.). During the first season these samples were separated into leaf and stem fractions and were analysed for nitrogen (Association of Official Analytical Chemists,1980) and *in vitro* digestibility (Minson & McLeod, 1972). Pasture availability was estimated by means of a pasture disc meter (Bransby & Tainton, 1977) in one of the grazing camps allocated to each group, just prior to when the animals entered and after the animals vacated the camps. A total of 50 readings per 0.05 ha were taken and dry matter available was estimated by means of the regression equation, $y = 1101 + 156.06\,d$, where y = yield in kg DM/ ha and d = mean pasture meter disc height (Bartholomew, 1985).

The lambs were graded on the hoof by experienced graders at the commencement, on day 45 and at the termination of the trial.

Livemass gains in the lambs were subjected to an analysis of variance.

Results

The influence of treatment on the total mass gain and average daily gain (ADG) in the lambs over the experimental period is summarized in Table 1. An analysis of variance indicated that stocking rate, supplement and the administration of a growth implant exerted a significant ($p \leq 0.05$) influence on mass gain in the lambs on pasture.

It is furthermore evident from Table 1 that lambs which received the molasses meal (Treatments 2, 5, 8, 11) and the molasses meal plus ionophore (Treatments 3, 6, 9, 12) achieved considerably more A3/A4 and A2 grades (measured on the hoof) than the lambs which received no such supplements (Treatment 1, 4, 7, 10). This response to the supplementation was more marked in the lambs subjected to the light than to the heavy stocking rate and was not markedly influenced by the provision of the growth stimulant (Table 1).

Overall, the main treatment effects (stocking rate, energy supplement and growth implant) on lamb performance are summarized in Table 2. Lambs subjected to the light stocking rate gained 1.0 kg more over the season than those subjected to the heavy rate. Furthermore, lambs which received molasses meal and ionophore gained 1.8 kg more than those which received molasses meal only and 4.5 kg more than those which received no supplement. On average, lambs which were implanted with the growth stimulant gained 1.7 kg more thah those which received no implant.

Table 3 summarizes rumen ammonia and volatile fatty acid levels prior to the initiation of treatments (day 0) and once treatments were initiated (day 45, 90). Owing to the similarity of values at 45 and 90 days after initiation, mean values are reported. It is noticeable that ammonia levels decreased from about 40 mg/100 ml before the initiation of treatments to about 20 mg/100 ml rumen fluid at days 45 to 90 of the treatments. Treatments appear to have little effect on rumen ammonia content. Treatments also had little effect on the molar percentages of acetic, propionic and butyric acid in the rumen.

Figure 1 illustrates the amount of pasture available in selected camps prior to and after grazing of the ryegrass. Slightly more grass appeared to be available to, and remained ungrazed by lambs which received the molasses meal or molasses meal and ionophore, than the lambs which received

Table 2 Effect of stocking rate, supplementary feeding and growth implant on mass gain in lambs on irrigated Italian ryegrass (*Lolium multiflorum*) pasture (see text for details on supplementary feeding and implant)

Treatment	Mean mass gain (kg)	Significance
Stocking rate		
Light (55 lambs/ha)	10.3	
Heavy (68 lambs/ha)	9.3	$p < 0.05$
Supplementary feeding		
Nil (control)	7.3	
Molasses meal	10.0	$p < 0.01$
Molasses meal + ionophore (lasalocid)	11.8	$p < 0.01$
Growth implant		
Nil (control)	8.9	
Implant (zeranol)	10.6	$p < 0.05$

Table 3 Effect of an ionophore and molasses meal supplements on the ammonia and volatile fatty acid levels in rumen fluid samples of lambs on Italian ryegrass (*Lolium multiflorum*) pasture

						RumenVFA* (molar%)		
Stocking rate (lambs/ha)	Treatment	Molasses meal (g/ lamb/day)	Ionophore (mg/lamb/ day)	Day of sampling rumen fluid	Rumen ammonia* (mg N/100 ml)	Acetic acid	Propionic acid	Butyric acid
55 (light)								
	1,4	0	0	0	40.8	54	19	16
				45, 90	19.3	58	23	15
	2,5	250	0	0	49.0	51	26	16
				45, 90	17.8	53	27	15
	3,6	250	35	0	46.6	53	26	16
				45, 90	23.6	54	26	15
68 (heavy)								
	7.10	0	0	0	47.8	53	25	16
				45, 90	24.3	58	24	14
	8,11	250	0	0	43.7	54	25	16
				45, 90	19.3	53	27	16
	9,12	250	35	0	47.9	52	24	19
				45, 90	19.3	51	26	18

*Values are the mean levels measured on days 45 and 90 after applying treatments

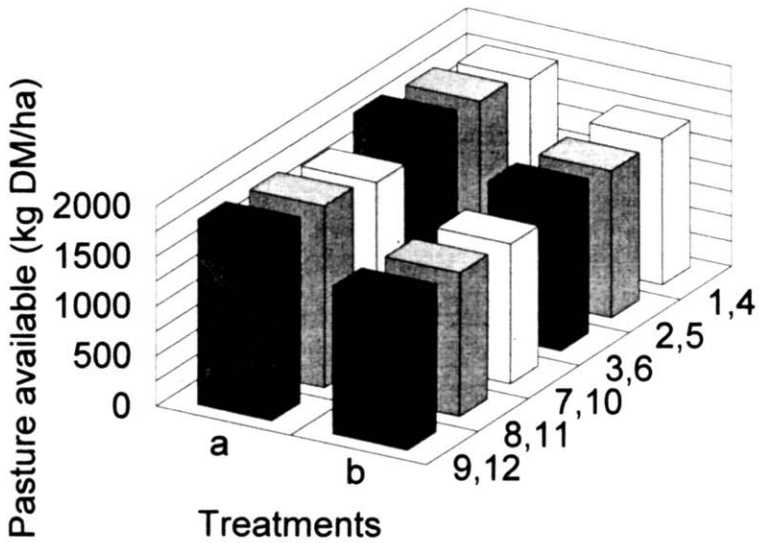

Figure 1 Availability of Italian ryegrass prior to grazing (a), and after grazing (b) by lambs not supplemented (Treatments 1, 4, 7, 10) and lambs supplemented with molasses meal (Treatments 2, 5, 8, 11), or molasses meal and an ionophore (Treatments 3, 6, 9, 12).

no supplement. This finding was more marked in the lambs subjected to the light than to the heavy stocking rate.

Nitrogen levels in the hand-clipped grass samples tended to decrease from 2.44% (DM basis) at the start of the grazing (early September) to 2.08% at the end of the grazing period (late November). At the heavy stocking rate, the slightly taller grass available to the lambs which received the molasses meal (treatments 8,11,9,12) had mean seasonal nitrogen levels of 2.18%, compared to 2.38% in the shorter grass available to the unsupplemented lambs (treatments 7,10). No such difference was evident at the light stocking rate. The *in vitro* dry matter digestibility of the ryegrass was unaffected by treatment and decreased from about 78% at the start, to about 71% at the end of the grazing period.

The leaf to stem ratio of the ryegrass subjected to the different treatments during the 1989 season is summarised in Table 4. In all the treatments there was a tendency for the proportion of leaf to decrease as the grazing season advanced. Towards the end of the season the relatively short grass available to the unsupplemented lambs (treatments 1,4,7,10) had a higher proportion of leaf than the relatively long grass available to the lambs which received the molasses meal. This effect was more marked at the light than at the heavy stocking rate (Table 4).

Table 4 Nitrogen content, relative digestibility *in vitro* (IVDMD), and leaf to stem ratio (L:S) of Italian ryegrass (*Lolium multiflorum*) samples cut at grazing height

	Hand clipped ryegrass samples					
	Start of trial (01\09\89)			End of trial (20\11\89)		
Treatment	N (%)	IVDMD (%)	L:S (%)	N (%)	IVDMD (%)	L:S (%)
1, 4	2.59	80.1±0.90	86:14	1.92	69.9±1.50	65:35
2, 5	1.86	75.0±0.00	79:21	2.10	71.6±0.50	45:35
3, 6	2.54	75.1±0.70	86:14	1.73	73.6±2.60	27:73
7, 10	2.76	79.8±1.20	81:19	2.38	74.0±0.00	56:44
8, 11	2.47	78.6±0.60	86:14	2.19	72.6±0.60	55:45
9, 12	2.42	78.4±0.20	81:19	2.16	65.4±0.60	52:48
Mean	2.44	77.8	83:17	2.08	71.2	50:50

Table 5 summarises the worm egg count and the coccidia oocyst levels in the lambs on ryegrass. It is evident that worm counts were relatively low, irrespective of treatment and did not change much over the grazing season. The coccidia oocyst levels tended to decrease as the grazing period progressed in the lambs subjected to all treatments (Table 5).

Discussion and conclusion

The quantity of pasture available to ruminants is the most important factor affecting performance levels (Heany, 1970 cited by Meissner *et al.*, 1989; Waldo & Jorgensen, 1981). The decrease in the level of lamb performance with an increase in stocking rate confirms this well-established relationship described by Jones & Sandland (1974). The significant influence on mass gains in the lambs on ryegrass owing to stocking rate (Table 1&2) obtained in this study is also in agreement with the finding by De Villiers *et al.*, (1993) that stocking rate on ryegrass exerts a major influence on the growth of lambs prior to weaning. It is thus evident that the choice of stocking rate is one of the

Table 5 The effect of supplement on mean worm egg count and coccidia oocyst levels in lambs on Italian ryegrass (*Lolium multiflorum*)

Treatment	Molasses meal (g/lamb/day)	Ionophore (mg/lamb/day)	Day of sampling	Worm egg counts/g faeces	Coccidia oocyst levels/g faeces
1, 4, 7, 10	0	0	0	150	6300
			30	250	6625
			90	350	735
2, 5, 8, 11	250	0	0	325	5500
			30	500	2514
			90	650	1100
3, 6, 9, 12	250	35	0	300	3925
			30	350	550
			90	400	788

most important decisions facing producers who wish to finish off lambs on ryegrass pasture.

The improved mass gains owing to molasses meal and molasses meal plus ionophore were reflected by the improved grades achieved by the lambs at the end of the grazing period (Table 1). The positive and significant response of 2.7 kg per lamb over the control in response to the provision of energy supplement, is in agreement with results obtained at the Cedara Research Station, where *ad lib.* energy supplementation to Mutton Merino lambs, improved ADG above that of the control group by 20% (J.F. de Villiers, pers. comm.).

The energy value of the total diet of the lambs which received the molasses meal was probably higher than that of the lambs which received the ryegrass only, considering the energy values of ryegrass (10.2 to 11.2 MJ ME/kg DM) and molasses meal (11.5 MJ ME/kg DM). The molasses meal could have provided more readily available energy than the ryegrass and consequently led to more favourable protein metabolism in the rumen, in the presence of high ammonia-nitrogen levels.

It seems likely that the slightly taller grass available to the supplemented lambs resulted in a greater scope for selection than the unsupplemented lambs which had access to relatively short grass. It is of interest that this short grass available to the unsupplemented lambs had a higher proportion of leaf and less stem and more protein than the taller grass available to the supplemented lambs, which had more stem and less leaf (Table 4).

It is known that ionophores improve the efficiency of feed conversion, via the production of more propionic acid and less acetic acid (and consequently smaller energy loss) than when no ionophore is provided (Horton & Stockdale,1981). This appears to have resulted in a slightly lower requirement for pasture and a slightly larger proportion of grass left ungrazed by the lambs which received the ionophore and molasses meal than for those which did not.

The lower coccidia oocyst level in the ionophore-supplemented lambs is in agreement with the finding that ionophores reduce coccidia counts (Stewart, 1991). However it is unlikely that the observed small reduction in coccidia count could have contributed much to the lower performance of the unsupplemented lambs compared to the ionophore-supplemented animals.

The fact that rumen ammonia levels from both the supplement treatments and the treatments without supplement decreased from about 40 mg N/100 ml rumen fluid at the outset of the grazing period to approximately 20 mg N/100 ml after 45 and 90 days of grazing (Table 3), suggests that the reduction was due to the decrease in nitrogen level of the grass later in the season. The reason

for the lack of a clear response in the propionic acid to acetic and butyric acid ratio in the presence of ionophores is not clear. During the first year of the study there was a slight tendency for acetic acid levels to decrease and propionic acid levels to increase over the grazing period in the lambs which received the ionophore, but no such trend was evident during the second grazing season.

Assuming 1998 input and product prices the value of the additional gain and the improved carcass grade, owing to the supplementation of the molasses meal and the ionophore and the provision of a growth stimulant is about R24.36 at R7.00 per kilogram live weight. The additional cost to achieve this was about R18.66. It is therefore clear that supplementation of lambs with molasses meal and an ionophore as well as a growth stimulant is a strategy which can be profitably utilised by sheep producers who fatten lambs on ryegrass pasture.

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