

GROWTH PERFORMANCE OF LAMBS UNDER INTENSIVE, CONTINUOUS AND ROTATIONAL GRAZING SYSTEMS OF MANAGEMENT

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ABSTRACT

A trial was conducted to assess the growth performance of lambs under intensive, continuous and rotational grazing systems of management in indigenous ewe lambs, aged 4-5 months. They were randomly selected and allotted to three treatment groups: T₁ (Intensive system – control), T₂ (Rotational grazing) and T₃ (Continuous grazing). The three treatment groups were compared for fortnightly bodyweight, average daily gain, fecal egg count (EPG). An artificial pasture was developed with *Panicum maximum* (Guinea grass), *Stylosanthes* sp., *Desmanthus* sp., and *Cenchrus ciliaris* (Buffel grass) for the lambs under grazing systems. The Lambs under T₁ were raised under stall fed system of management, the lambs under T₂ were grazed under rotational grazing strategy in the four paddocks (2500 sq. ft. each) of plot-A while the lambs under T₃ were continuously grazed in plot-B (10000 sq. ft.). At the end of the study period, statistical analysis revealed no significant difference between the treatment groups in fortnightly body weight as well as average daily gain (except for the fourth fortnight). However lambs under T₂ had better mean fortnightly body weight and average daily gain. Significant differences were noticed in EPG (for Strongyle eggs) and biomass yield of fodder. Lambs under T₂ had significantly (P≤0.01) lower E.P.G. than T₃. Plot-A under rotational grazing had significantly (P≤0.01) higher fodder biomass yield and comparatively higher crude protein content than plot-B under continuous grazing. The results of this study pointed towards benefits in terms of lower EPG and better quantity and quality of biomass in rotational grazing compared to continuous grazing.

Keywords: Rotational grazing, Continuous grazing, Ewe lambs, Growth Performance

India possesses 65.06 million husbandry forms an integral part of rural sheep (19th Livestock census- All India agrarian economy of arid and semi-arid report, 2012). The multi-faceted sheep zones of India. Sheep is mainly raised

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under extensive system of management and grazing in natural range lands is the predominant source of nutrition.

The poor productivity of Indian pasture has always been a saddening fact. Shankar and Gupta (1992) classified the Indian grazing lands as fragile eco-systems and ranked them as class IV and V in their land capability classification. The carrying capacity of our native rangeland is 0.20 to 1.47 adult cattle unit (A.C.U) / ha.,but the present stocking rate happens to be much higher.

The extensive system involving grazing also suffers from the worm nemeses. The parasites play a major part in contributing to the production losses of sheep husbandry in India. Further, overuse of anthelmintics has raised the problem of drug resistance in field conditions.

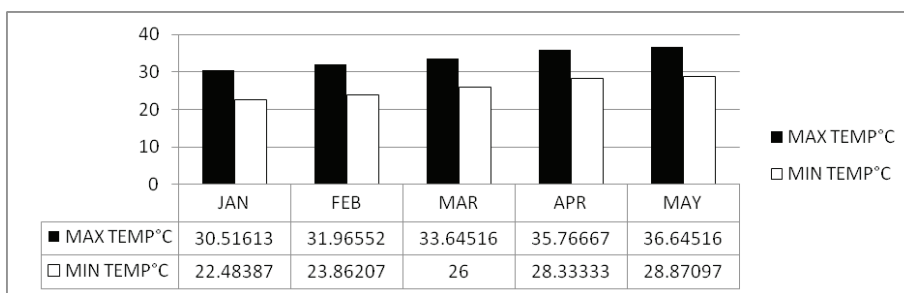
The concept of creating artificial pasture for animals has been cropping up lately in few countries like Turkey and China. These pasture promise better biomass and nutrient availability than the native rangeland (Acaret *al.*, 2010). Moreover, the system of grazing has been found to affect the quantity and quality of

biomass yield from developed pastures. Grazing management with pasture rotation plays a major role in sustainable helminth control in livestock as reported by Waller (1997), Bukhari and Sanyal (2011) and Kumar *et al.* (2013). In the present study the concept of developed pasture for sheep rearing was investigated. The seasonal pasture biomass and herbage dynamics of the artificial pastures were also observed. The production performance of indigenous ewe lambs and exposure to helminth infection under different systems of grazing in developed pasture was studied.

MATERIALS AND METHODS

Experimental location: The experiment was carried out at University Research Farm, TANUVAS, Chennai-51. It lies between latitudes 12° 9' and 13° 9' and longitudes 80° 12' and 80° 19' E with an altitude of 22 m above MSL. The experiment was conducted for a period of five months from January 2016 to May 2016. The maximum and minimum temperature recorded during the experimental period was 36.64°C and 30.51°C respectively. Rainfall was observed in the month of January (0.95 mm) and May 2016 (185.55 mm). The maximum and minimum temperature during the experimental period is given in Fig.-1.

Figure-1 Maximum and minimum temperature of the experimental location



Animals and pasture management: The trial was conducted with thirty indigenous ewe lambs in the age group of 4-5 months maintained at the University Research Farm, Madhavaram. The experimental animals were dewormed before the start of the experiment.

Ten animals were randomly allotted based on body weight to the following three treatment groups: T₁ (Intensive system – control), T₂ (Rotational grazing) and T₃ (Continuous grazing). The Lambs under T₁ were raised under stall fed system of management and was sheltered in pens on slatted floor made of wooden slats of 4 cm width. The gap between slats was 18 mm. The slatted floor was elevated 2 feet from the ground level. The lambs under intensive system were fed with cereal and leguminous fodder *ad-libitum* in the ratio of 1:1.

An artificial pasture of 0.18 hectare was developed with *Panicum maximum* (Guinea grass), *Stylosanthes* sp., *Desmanthus* sp., and *Cenchrus ciliaris* (Buffel grass) for the lambs under grazing systems. The lambs after grazing were sheltered in night shelters. All the experimental animals were supplemented with 100 g of concentrate per day.

Grazing management: The Lambs under T₂ were grazed under rotational grazing strategy in the four paddocks (2500 sq. ft. each) of plot-A while the lambs under T₃ were continuously grazed in plot-B (10000 sq. ft.). The grazing period was 4-5 days in each paddock since the infective stage of *Haemonchus contortus* L₃ takes 7 days to develop (Colvin *et al.*, 2009).

Rest period was 15 days per paddock since the fodder biomass was optimum at this stage. A rest period, more than 15 days was not practically applicable as the biomass was surplus at this stage. Further, Guinea grass after 15 days of rest period had a sward length more than 15 cm which makes parasite prevalence less (Kumar *et al.*, 2013) in the top surface of the sward to be consumed by the lambs.

The animals under treatment 3 were allowed for continuous grazing in the plot-B. Animals under both the systems of grazing were allowed to graze for a period of 6-8 hours.

Experimental sampling and analysis: A wooden quadrat of 1 m² was made and was swung from the center of the paddock to attain randomness in selection of area to be harvested for biomass estimation (Onatibia and Aguiar 2016). The herbage in area under wooden quadrat was clipped and weighed and then extrapolated to calculate fodder biomass of the plot in terms of dry matter yield expressed in Tons per hectare. Analysis of dry matter, crude protein, crude fibre, ether extract and total ash of the fodder samples were carried out as per AOAC, (2005).

The body weight and average daily gain (g) of all the experimental animals were recorded fortnightly with an electronic digital weighing balance with 50 g accuracy. The parasitic burden was assessed by fecal examination-direct floatation method and the eggs were enumerated using the McMaster technique following standard protocol.

The carrying capacity of the developed pasture involved in this experiment was calculated in terms of A.C.U(1 A.C.U = 0.2 Sheep) irrespective of the biomass availability of the pasture.

Carrying capacity / hectare = Animal units involved in this experiment X 10.8

Statistical Analysis: The data collected were subjected to statistical analysis as per the method suggested by Snedecor and Cochran (1994).

RESULTS

The fortnightly body weights of lambs pertaining to the different treatment groups are on Table-1. Statistical analysis revealed no significant difference in fortnightly body weights of lambs under different system of management. However lambs, under rotational grazing system had comparatively better body weights, than those under intensive system and continuous grazing system of management.

Table-1: The fortnightly mean \pm S.E and analysis of variance of body weights (kg) of lambs under different treatment groups

Fortnights	T ₁ (Intensive system)	T ₂ (Rotational Grazing)	T ₃ (Continuous Grazing)	P value
1	13.03 \pm 0.64	12.10 \pm 0.68	11.94 \pm 0.80	0.55 ^{NS}
2	13.48 \pm 0.59	12.38 \pm 0.72	12.64 \pm 0.75	0.55 ^{NS}
3	13.81 \pm 0.63	12.92 \pm 0.83	12.79 \pm 0.63	0.58 ^{NS}
4	14.30 \pm 0.52	12.99 \pm 0.90	14.01 \pm 0.83	0.49 ^{NS}
5	15.13 \pm 0.52	13.70 \pm 0.93	14.04 \pm 0.89	0.47 ^{NS}
6	16.02 \pm 0.48	14.90 \pm 1.06	14.71 \pm 0.90	0.55 ^{NS}
7	15.79 \pm 0.74	16.07 \pm 1.15	15.70 \pm 0.65	0.94 ^{NS}
8	16.46 \pm 0.68	16.97 \pm 1.16	16.12 \pm 0.92	0.83 ^{NS}
9	16.59 \pm 0.60	16.95 \pm 1.07	16.00 \pm 0.93	0.85 ^{NS}
10	16.67 \pm 0.64	17.91 \pm 1.2	16.10 \pm 0.90	0.78 ^{NS}

The fortnightly average daily weight gain in lambs pertaining to different treatment groups are given in Table-2.

Table-2: The fortnightly mean± S.E of average daily weight gain (g) and analysis of variance of lambs under different treatment groups

Fortnights	T ₁ (Intensive system)	T ₂ (Rotational Grazing)	T ₃ (Continuous Grazing)	P value
1	52.8 ± 16.1	30.1 ± 26.4	17.8 ± 15.3	0.46 ^{NS}
2	32.1 ± 08.7	20.0 ± 14.8	49.3 ± 23.5	0.47 ^{NS}
3	23.5 ± 14.2	38.0 ± 18.3	10.7 ± 16.1	0.49 ^{NS}
4	35.0 ^b ± 16.5	05.0 ^b ± 10.1	90.0 ^a ± 18.8	0.00 ^{**}
5	59.2 ± 07.9	50.0 ± 33.1	10.7 ± 16.2	0.26 ^{NS}
6	63.5 ± 20.9	85.7 ± 37.3	36.4 ± 26.5	0.49 ^{NS}
7	15.0 ± 15.9	83.5 ± 25.2	70.7 ± 32.3	0.14 ^{NS}
8	47.8 ± 11.5	64.0 ± 17.1	30.0 ± 35.3	0.59 ^{NS}
9	09.2 ± 07.9	07.8 ± 04.4	02.8 ± 03.8	0.70 ^{NS}
10	05.7 ± 04.1	07.8 ± 9.37	07.1 ± 10.4	0.82 ^{NS}
Overall Weight Gain	25.5 ± 2.87	36.3 ± 5.11	29.6 ± 5.16	0.28 ^{NS}

NS – Not Significant

** Significant at one per cent level (P<0.01)

The overall average daily gain recorded was 25.5 ± 2.87, 36.3 ± 4.84 and 29.6 ± 4.90 grams for the animals in T₁, T₂ and T₃ respectively. There weren't any significant difference in all the fortnightly average daily weight gains belonging to different treatment groups except the fourth fortnight (P<0.01).

The fortnight Strongyle E.P.G in lambs pertaining to various treatment groups are in Table-3.

Table-3: The mean \pm S.E and analysis of variance of fortnightly Strongyle E.P.G in lambs of three treatment groups

Fortnights	T ₁ (Intensive system)	T ₂ (Rotational Grazing)	T ₃ (Continuous Grazing)	F value
1	1860 ^c \pm 0155.00	4310 ^b \pm 1173.0	7170 ^a \pm 701.9	0.000**
2	2700 ^b \pm 0614.00	3500 ^b \pm 967.0	7480 ^a \pm 788.0	0.001*
3	2270 ^b \pm 1004.00	3020 ^b \pm 710.0	7280 ^a \pm 617.0	0.000**
4	2840 ^b \pm 0854.00	3260 ^b \pm 791.0	6970 ^a \pm 817.0	0.001**
5	2810 ^b \pm 0838.70	3390 ^b \pm 797.1	6943 ^a \pm 817.0	0.003**
6	1760 ^b \pm 0337.00	3850 ^a \pm 645.0	4570 ^a \pm 508.0	0.002**
7	1230 ^b \pm 0289.00	3130 ^a \pm 459.0	4380 ^a \pm 789.1	0.002**
8	1250 ^b \pm 0216.10	2220 ^b \pm 562.8	4150 ^a \pm 897.0	0.009**
9	1120 ^a \pm 0191.30	1980 ^{ab} \pm 246.0	3760 ^a \pm 1098.0	0.026*
10	1260 ^a \pm 0224.00	1960 ^{ab} \pm 317.0	3700 ^a \pm 983.0	0.025*

* Significant at five per cent level (P<0.05)

** Significant at one per cent level (P<0.01)

Means bearing different superscript in the same column differ significantly

There was a highly significant difference (P<0.01) in the fortnightly Strongyle E.P.G in lambs pertaining to the three treatment groups. The lambs in T₃ had a significantly higher Strongyle E.P.G compared to T₂ and T₁.

The monthly fodder biomass yield (tones/hectare) of pasture plots A (Rotational grazing) and B (continuous grazing) are given in Table- 4. The monthly fodder dry matter yield in the plot-A was significant higher (P<0.01) when compared to plot-B.

Table-4: Mean±S.E of fodder biomass (DM) yield (tons/hectare) and Independent t-test of the experimental plots

Experimental Plots	Months				
	January	February	March	April	May
Rotational Grazing- PLOT A	3.50±0.013	6.13±0.008	5.55±0.006	4.38±0.003	3.22±0.009
Continuous Grazing- PLOT B	3.24±0.005	1.46±0.005	1.30±0.005	1.70±0.05	1.72±0.05
‘P’ Value	0.34	0.00*	0.00**	0.00**	0.00**

** Significant at one per cent level (P<0.01)

Table-5: Proximate composition (in percentage) of fodder samples pertaining to the experimental Plot A and B

Plot-A	Crude protein	Ether Extract	Total Ash	Acid Insoluble Ash	Crude Fibre
Start of the trial (January)	7.92±0.03	2.93±0.03	9.02±0.05	6.5±0.03	19.03±0.03
Mid trial (March)	6.95±0.49	2.55±0.02	7.97±0.03	6.4±0.02	20.15±0.08
End of the trial (May)	5.97±0.59	2.67±0.01	7.31±0.12	5.6±0.02	22.16±0.08
Plot-B					
Start of the trial (January)	7.42±0.01	2.14±0.01	7.8±0.10	5.5±0.02	24.47±0.03
Mid trial (March)	5.21±0.24	2.43±0.01	9.9±0.04	5.5±0.03	22.85±0.08
End of the trial (May)	5.24±0.01	2.67±0.02	9.9±0.03	5.8±0.02	21.89±0.04

The proximate composition of fodder samples taken during the start of the trial, mid period of the trial and during the end of the trial pertaining to plots A and B are given in Table-5.

There weren't any difference in the proximate principles observed at various intervals between plots A and B. But a seasonal decrease in the crude protein content of the fodder samples was observed from winter to summer seasons in both the experimental plots.

DISCUSSION

Growth performance of lambs: The statistical analysis of the body weights (kg) and average daily gain (g) of lambs under intensive, continuous and rotational systems of grazing management in general revealed no difference. In a similar study with Barbari goats Mahanthaet *al.* (2012) observed no statistical difference in body weight between continuous, rotational and deferred rotational systems of grazing. In contrast, Sharrow and Krueger (1979) observed a 10 per cent increase in the weight gain of lambs under rotational grazing in a study on performance of Romney ewes under rotational and continuous system of grazing.

Though the difference in body weight of lambs reared under different systems of management was not significant statistically, lambs reared under rotational system of grazing had comparatively better weight gain than the other two treatments groups. This was in accordance with the findings of Bozkurtet *al.* (2015) who observed that there was a tendency of beef

cattle to perform better in the rotational system of grazing management. The final body weight and the average daily gain of the lambs in all the three treatment groups were lower since the lambs subjected to the trial was 5 months of age and has passed the active growth phase period during the experimental period.

Parasitic load: In our present study the Strongyle E.P.G of feces differed significantly ($P \leq 0.01$) between the lambs pertaining to different treatment groups. The lambs under rotational grazing system of management had significantly lower E.P.G than those under continuous grazing system of management. The lowest E.P.G was observed in lambs under intensive system of management. Majority of the parasite larvae (80%) lives in the first 5 cm of the vegetation. The rest period of 15 days ensured that the sward height of grasses in the rotational system of grazing paddocks remained more than 20 cm at any given point of time. However, the sward height of grasses in the continuously grazed paddocks remained well below 10 cm. This might have influenced the E.P.G. resulting in reduced E.P.G count in lambs under rotationally grazed paddocks.

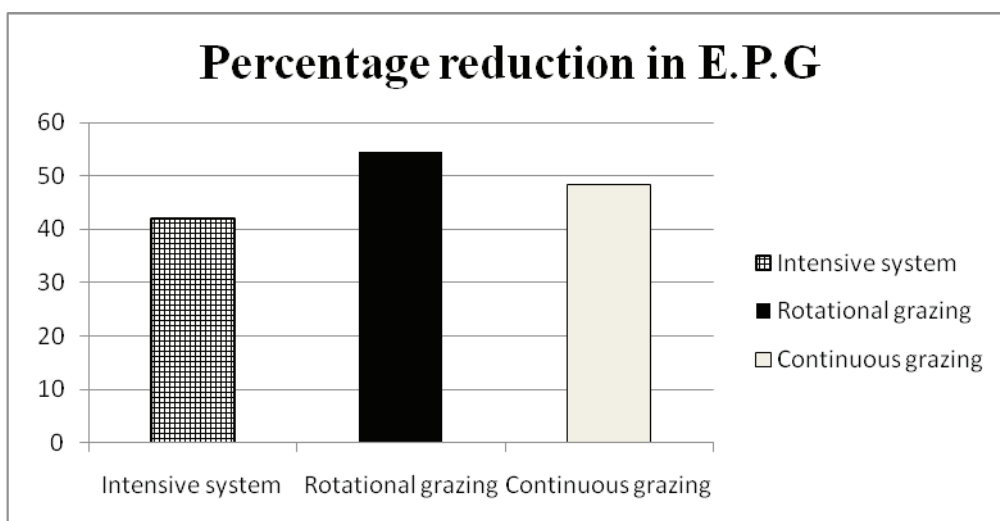
The overall percentage of reduction in E.P.G was higher in T₂, which was 54 per cent. Irrespective of the system of grazing management, a general tendency in decline of E.P.G. was observed from the month of January to May i.e. from winter to summer season. The increase in average monthly temperature from winter to summer which was not conducive for the survival of infective larval stages, might have contributed to the lower E.P.G count

towards summer season. The seasonal influence in E.P.G. of lambs observed in the present study was in accordance with the findings of Soundarajan (2001).

Fodder biomass and herbage dynamics: In this study the rotational grazing plot-A had a significantly ($P \leq 0.01$) higher fodder biomass yield than the continuous grazing plot-B as observed in

Table-4. This was in agreement with the observation of Onatibia and Aguiar 2016, Upadhyayet *al.* (1971) and Das and Paroda (1980). The prevalence of green biomass, a lesser standing or dead biomass and absence of bare-ground area were observed in the rotationally grazed paddocks when compared to the continuously grazed plot. A similar trend was observed by Kurtz *et al.* (2015) and Teague *et al.* (2011).

Figure-2: Overall percentage of reduction in different treatment groups



Further, comparatively more weed infestation was observed in the continuously grazed paddocks. Similar observations were reported by Virosteket *al.* (2015). It can be observed from the results that rotationally grazed plots had better crude protein content than the continuously grazed plots. Moreover, a seasonal decrease in the crude protein content from winter to summer seasons was observed in both the experimental plots.

The higher crude protein percentage content in the rotational grazing paddocks shall be attributed to the accentuating nitrogen content in Plot-A under rotational grazing due to uniform and extensive footfalls of lambs. These observations are in line with the findings of Shinde (1997), Walton *et al.* (1981), Turk *et al.* (2014) and Mahanthaet *al.* (2012). In concurrence with results of the present study, Shinde *et al.* (1997) also observed seasonal variation in the proximate composition of fodder grasses.

The developed pasture of 10,000 sq. ft. involved in this experiment has supported 10 lambs so the carrying capacity of pasture irrespective of biomass availability throughout the experimental period and hence the approximate carrying capacity is 21.6 A.C.U., whereas, it is only 0.2-1.47 A.C.U / hectare under conventional grazing system of management.

Results of this study indicate advantages of rotational grazing in terms of better biomass yield from pasture (quality and quantity) and lesser infestation of weeds. The lambs raised under rotational grazing system had a significantly ($P \leq 0.01$) lower E.P.G than those under continuous system of grazing thereby assuring reduced cost on deworming and better health of lambs. This study explores the first baseline of sheep rearing in artificial pasture under rotational grazing; further investigation on this area may yield more favorable and reliable results.

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