EFFECTS OF GRAZING MANAGEMENT AND LEVELS OF CONCENTRATE SUPPLEMENTATION ON PARASITE ESTABLISHMENT IN TWO GENOTYPES OF LAMBS INFECTED WITH *HAEMONCHUS CONTORTUS*

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ABSTRAK

GINTING, SIMON P., K.R.POND. dan SUBANDRIYO. 1996 Pengaruh sistem penggembalaan dan tingkat suplementasi pakan terhadap perkembangan cacing parasit pada dua galur domba yang diinfeksi dengan *Haemonchus contortus*. *Jurnal Ilmu Ternak dan Veteriner* 2 (2): 114-119.

Penelitian bertujuan untuk mempelajari pengaruh sistem penggembalaan dan tingkat pemberian suplemen pakan terhadap perkembangan cacing parasit dan akibatnya terhadap penampilan dua galur domba yang diinfeksi dengan *Haemonchus contortus*. Digunakan 36 ekor domba persilangan St. Croix x Sumatera (HC) dan 36 ekor domba Sumatera lokal (S) yang diberi suplemen pakan sebanyak 0,5 % bobot badan (BB) atau 1,6 % BB.Domba diinfeksi dengan larva *Haemonchus* (L_3) sebanyak 3.000 L_3 per ekor dan digembalakan pada pastura *Brachiaria brizantha* yang bebas cacing parasit. Pada minggu ke-18, total telur per gram tinja (TTGT) pada domba GM1(pastura dengan siklus penggembalaan 6 minggu) mencapai 3.936 ± 1.525, pada saat itu 29 % dari seluruh domba memiliki PCV darah berkisar antara 7,8 - 14,6%. Pada GM3 (pastura dengan siklus penggembalaan 12 minggu) TTGT mencapai 6.714 ± 2.075 pada minggu ke-28, pada saat itu 24% dari seluruh domba memiliki PCV darah berkisar antara 7,9 - 13,3%. Pada periode tersebut semua domba pada GM1 atau GM3 diberi obat cacing untuk mencegah kematian ternak. Walaupun secara keseluruhan rata-rata TTGT (4.543 ± 318) pada domba GM2 (pastura digembalakan selama 1 minggu dan diistirahatkan selama 6 minggu) lebih tinggi (P<0,001) dibandingkan dengan domba pada GM1 (2.944 ± 325) atau pada GM3 (2.159 ± 418), namun tingkat infeksi ini dicapai tanpa pemberian obat cacing, oleh karena selama penelitian hanya 11% ternak GM2 yang pernah mencapai PCV darah, 15%. Pada domba yang diberi suplemen 1,6% BB, TTGT lebih rendah (P<0,001) sedangkan PCV dan protein serum lebih tinggi dibandingkan pada domba yang diberi suplemen 0,5% BB. Pada pemberian suplemen 0,5% BB, TTGT tidak berbeda (P>0,10) antara HC dan S, tetapi pada pemberian 1,6% BB, TTGT pada HC lebih rendah (P<0,001). Disimpulkan bahwa dalam upaya pengendalian cacing parasit di pastura, sistem penggembalaan dengan masa penggembalaan satu minggu yang diikuti dengan masa istirahat 6 minggu lebih baik dibandingkan dengan penggembalaan dengan siklus 6 atau 12 minggu. Perbaikan status gizi lewat suplementasi pakan dapat menekan perkembangan cacing parasit baik pada domba HC maupun S.

Kata kunci: Penggembalaan, *Haemonchus contortus*, suplemen pakan, domba

ABSTRACT

GINTING, SIMON P., K.R. POND, and SUBANDRIYO. 1996. Effects of grazing management and levels of concentrate supplementation on parasite establishment in two genotypes of lambs infected with *Haemonchus contortus*. *Jurnal Ilmu Ternak dan Veteriner* 2 (2): 114-119.

The effects of grazing systems, levels of feed supplementation and genotypes of sheep on the establishment of *Haemonchus contortus* were studied in 36 St. Croix x Sumatra crosses (HC) and 36 Sumatra (S) male lambs. The lambs were artificially infected with *Haemonchus* larvae (L_3) at a rate of 3,000 L_3 per animal and fed concentrate supplement at 0.5% body weight (BW) or at 1.6% BW. The animals grazed clean *Brachiaria brizantha* pastures. Lambs grazing GM1 (grazing system with a 6-week rotational cycle) had egg counts of 3,936 ± 1.525 at week 18, and 29% of the lambs had PCV ranging from 7.8 to 14.6%. Lambs in GM3 (grazing system with a 12-week grazing cycle) had egg counts of 6,714 ± 2,075 at week 28, and 24% of the lambs had PCV ranging from 7.9 to 13.3% At these periods, all lambs in both GM1 and GM3 were dosed with anthelmintics to prevent the death of the animals. Although the overall mean egg counts (4,543 ± 318) of lambs on GM2 (grazing system with a 1-week grazing and 6-week resting periods) were higher (P<0.001) than on GM1 (2,944 ± 325) or on GM3 (2,159 ± 418), it was achieved without dosing with anthelmintics, since only 11% of the lambs in GM2 ever reached PCV values less than 15%. Lambs fed supplements at 1.6% BW had lower (P<0.001) egg counts and higher (P<0.001) PCV and serum protein than lambs on 0.5 %BW supplement group. Egg counts and PCV values were not different (P>0.10) between HC and the S lambs when fed supplement at 0.5% BW, but on 1.6% supplement BW group, the egg counts were lower (P<0.001) in HC. It is concluded that a one-week grazing and a six- week resting system was superior than grazing systems with a 6- or 12-week rotational cycle. Improving the nutritional status of lambs by increasing the level of supplement offered could depress the establishment of *Haemonchus* in the lambs. The HC and S lambs showed similar response to supplements at 0.5% BW, but at 1.6% BW the HC responded better than the S.

Key words: Grazing management, *Haemonchus contortus*, feed supplement, sheep

INTRODUCTION

Endoparasite infection is a widespread constraint to sheep production where continuous grazing is practised. In tropical environments, the survival time of parasite larvae is relatively short, ranging from 4 to 10 weeks (AUMONT *et al.*, 1989). Hence, under these environmental conditions, there is potential for developing grazing management approaches to control parasites. It is uncertain, however, if reducing the time animals spend in a pasture by increasing the frequency of rotation or lengthening the rotational cycle can depress the population of parasites on pastures, and increase the productivity of the animals. Meanwhile, it is generally accepted that there is an interaction between level of nutrition and susceptibility to infection by parasitic worms, but the responses of infected sheep to different plane of nutrition has varied by breeds (ROBERTS and ADAMS, 1990)

The objectives of this study were to examine the effects of grazing management systems differing in grazing and resting periods, and levels of concentrate supplementation on parasite establishment in two genotype of sheep infected with *Haemonchus contortus*.

MATERIALS AND METHODS

Animals, pastures and grazing

A total of 72 male lambs of two genotypes (36 lambs per genotype) between 3 and 4 months of age were selected from a flock at the Suka Dame Station, Sungei Putih, North Sumatra. The genotype groups were Sumatra (S) and St. Croix x Sumatra crosses (HC) with initial body weight of 10.9 kg (± 2.3 kg) and 13.6 kg (± 2.4 kg), respectively.

Two separate adjacent land areas that had not been used for grazing livestock for at least the previous three months were planted to *Brachiaria brizantha* grass. Each land area was subdivided into two plots of equal size (replicate one and replicate two). Each land replicate was then subdivided into three plots of 0.25 ha for three grazing managements. The grazing management treatments were:

GM1-Grazed for 6 weeks and rested for 6 weeks,
GM2-Grazed for 1 week and rested for 6 weeks, and
GM3-Grazed for 12 weeks and rested for 12 weeks.

To provide for rotational grazing management, each plot of GM1 and GM3 were subdivided into two subplots (0.125 ha. each). Each plot of GM2 was divided into seven subplots (0.0357 ha. each). A pre-experiment cutting management was conducted to provide 6, 6 and 12 weeks regrowth on the first grazing rotation of GM1, GM2 and GM3. After each plot was cut, nitrogen was applied in the form of urea at the rate of 100 kg N/ha/year in a one-time application.

The animals were put in the assigned plots at approximately 08:00 hours and returned to barns at 12:00 hours each day. To prevent the animals from accidental infection by consuming forages that might had been contaminated by infective larvae, muzzles were used on each animal when traveling to and from the paddocks.

Supplementation

The feed supplement (Table 1) was formulated to contain 18% CP and 2.9 Mcal ME per kg dry matter of feed, which were considered adequate for moderate to high growth (KEARL, 1982). Animals that were assigned to high and low supplement were offered supplement at 1.6 and 0.5% of body weight, respectively (dry matter basis). The high and the low supplemented animals were grouped together in each rotational grazing treatment. Upon returning to the barn, the animals were grouped according to the grazing and supplementation treatments. The animals had free access to mineral blocks and water in the barns.

Table 1. Ingredient composition of concentrate supplement

Ingredient	% DM
Rice bran	39.42
Palm kernel cake	25.45
Molasses	20.51
Fish meal	10.78
Limestone	2.24
Salt	1.14
Bone meal	0.46

Culture of *Haemonchus* larvae for artificial infection

Two donor animals (Local Sumatra Thin-tail sheep) that had been repeatedly infected with *Haemonchus* larvae were used as the source of feces containing *Haemonchus* eggs. The recovery of larvae from the cultures was processed according to the procedure described by ROBERTS and O'SULLIVAN (1950).

Two weeks prior to artificial infection with the *Haemonchus* larvae animals were drenched with Ivermectin at a dose rate of 0.3 ml per kg body weight. At day 10 after drenching, fecal samples were taken from the rectum of each animal to confirm that all animals were free of gastro-intestinal parasites. All animals were infected orally with a culture of infective *Haemonchus contortus* larvae (L_3) at 3,000 L_3 per animal given in two equal doses with one day between doses.

Fecal egg counts and blood analyses

Starting from week two after larval infection, fecal samples were taken directly from the rectum of each animal biweekly and egg counts (epg) were examined the same day by a modified McMaster technique (URQUHART *et al.*, 1994). Blood for hematological analyses was collected biweekly by jugular vein puncture using an evacuated glass tube. Blood samples were analysed for packed cell volumes (PCV; hematocrit) and total serum protein. Serum was separated and protein concentration in the serum was determined using a clinical refractometer (American Caduceus Industries, Toledo, OH).

Estimation of larval contamination on pastures

Twelve lambs between three and four months of age were used as tracer animals to estimate the level of parasite contamination on pastures. Two lambs were randomly added to each of the three grazing-management treatments in each of the two replicates, when the subplots in GM1, GM2 and GM3 had been grazed and rested at least once according to the planned rotational intervals.

The tracer animals were allowed to graze in subplots with other experimental animals for seven days, and then removed from the pastures, placed in a barn, grouped into a separate pen and isolated from the other animals for the next 21 days. During this period, they were offered only parasite-clean forages. On day 28 after grazing, the tracer animals were slaughtered to determine the worm burdens.

Criteria for use of anthelmintics

To prevent the deaths of the experimental animals, a guideline for using anthelmintics was established at the beginning of the study. All animals within each grazing management would be treated with anthelmintics, when 50% of the animals within the grazing management had PCV value less than 15%, or when 25% of the animals had PCV values less than 13%.

Statistical analyses

Data (fecal egg counts, packed cell volume (PCV), serum protein, ADG, fecal output and feed intakes) were analysed as a split-plot design using the general linear procedures of SAS (1985). The model used was $Y = \mu$ + replicate + grazing management (GM) + $error_a$ + supplementation-genotype combinations (SG) + GM x SG + $error_b$. $Error_a$ (replicate x GM) was used to test for grazing management main effects. $Error_b$ (replicate x GM x SG) was used to test for the main effects of SG and the GM x SG interaction. Single degree of freedom for orthogonal contrast were used to compare the low vs. high supplement, the Sumatra vs. St.Croix crosses and the genotype x supplementation interaction. Differences among grazing management and among genotype-supplementation combinations were examined with the Waller-Duncan k-ratio t-test with K=100 (STEEL and TORRIE, 1980).

RESULTS AND DISCUSSION

The grazing management x supplement interaction was significant (P<0.001). The interaction, however, was due to differences in magnitude and not an alteration in ranks. Therefore, effects of grazing management and supplementation are presented separately.

Effects of grazing management

Fecal eggs counts, PCV and serum proteins

The pattern of egg counts (Table 2) suggests that the first peak counts were reached by week 6 after the infection for GM1 and GM2, and by week 4 for GM3. Egg counts from GM1 was 3,936 ± 1,525 at week 18, while from GM3 it was 6,714 ± 2,075 at week 28, during which approximately 29% of the lambs in GM1 and 24% in GM3 had PCV values less than 15% (ranged from 7.8 to 14.6%). These animals were very weak, had severe diarrhea and inappetance, indicative of clinical parasitism. To prevent the death of these animals, all animals on this grazing system were treated with Ivermectin. Counts from GM2 increased steadily following week 16, but only 11 % of the lambs ever reached PCV values less than 15%, and no anthelmintic treatment was given to the animals in this grazing management.

Table 2. Fluctuation of fecal egg counts in sheep from three grazing management systems

Week	Grazing management systems[a]		
	GM1	GM2	GM3
2	90 ± 53	234 ± 88	392 ± 168
4	1,994 ± 226	4,400 ± 490	3,741 ± 1,209
6	2,197 ± 522	4,778 ± 468	1,905 ± 587
8	1,492 ± 659	3,701 ± 753	1,437 ± 597
10	1,017 ± 484	2,538 ± 537	4,334 ± 312
12	977 ± 447	3,717 ± 1,026	542 ± 212
14	2,945 ± 1,028	2,201 ± 734	882 ± 294
16	681 ± 227	1,923 ± 626	200 ± 62
18	3,936 ± 1,525	5,656 ± 1,525	2,967 ± 665
20	2 ± 2	3,974 ± 979	3,215 ± 567
22	13 ± 4	3,873 ± 1,480	4,046 ± 869
24	2,378 ± 994	5,283 ± 1,992	5,034 ± 1,169
26	2,192 ± 718	7,232 ± 2,310	4,392 ± 1,435
28	2,983 ± 945	6,786 ± 1,991	6,714 ± 2,075
30	4,822 ± 1,365	4,680 ± 1,606	3 ± 2
32	10,008 ± 2,594	8,385 ± 2,480	102 ± 38
34	12,324 ± 3,371	7,873 ± 2,541	699 ± 158

[a]GMI=Two pastures in which one was grazed by animals for six weeks and then rested for six weeks
GM2=Seven pastures in which one was grazed by animals for one week and then rested for six week
GM3=Two pastures in which one was grazed by animals for twelve weeks and then rested for twelve weeks

The overall mean for egg count, PCV and serum protein is presented in Table 3. Sheep from GM2 had the highest (P<0.001) epg. However, this was achieved without receiving anthelmintics, and the higher epg from GM2 was not translated into lower PCV level indicating that the lambs could withstand the parasitism. The mean PCV of animals in each grazing management were all above the normal threshold level of 22% (BLOOD and RADOSTITS, 1989). The values, however, were relatively lower than the mean PCV values (28%) of lambs and young ewes before being given anthelmintic treatment in North Sumatra as reviewed by GATENBY and BATUBARA (1994).

Total serum protein for lambs on GM1 and GM3 were not different (P>0.10), but were higher (P<0.01) than for lambs grazing GM2 (Table 3). This suggests a close association between fecal egg numbers and the total serum protein. However, mean values in the three grazing systems are all below the normal threshold of 6.0 g/dl (BLOOD and RADOSTITS, 1989). This levels of serum protein and PCV are indicative of heavy infection.

Table 3. Epg, PCV and total serum proteins (mean + SE) from lambs infected with *Haemonchus contortus* under three grazing management systems

Treatment[a]	epg	PCV (%)	Serum Protein g/dl
GM1	2944 ± 325	23.7 ± 0.26	5.05 ± 0.04
GM2	4543 ± 318	23.3 ± 0.25	4.82 ± 0.03
GM3	2159 ± 418	23.1 ± 0.26	5.06 ± 0.04
MSD[b]	760	NS	0.09

[a]GM1=Two pastures in which one was grazed by animals for six weeks and then rested for six weeks
GM2=Seven pastures in which one was grazed by animals for one week and then rested for six week
GM3=Two pastures in which one was grazed by animals for twelve weeks and then rested for twelve weeks
[b]MSD=Waller-Duncan minimum significant difference

Worm burdens of tracer animals

Tracer animals grazing GM2 had the highes (P<0.01) worm burdens (Table 4). Worm burdens were not different (P>0.10) between GM1 and GM3. The lower worm burdens in animals grazing GM3 could be attributed to removal of the animal from the pasture for a longer period of time (12 weeks), which may have broken the life cycle of part of the larvae population. An alternative explanation could be attributed to differences in the sward heights of pastures in the three grazing management systems. Although not measured quantitatively, the sward height in GM3 was observed to be relatively taller than those in GM1 and GM2, when the tracer animals were exposed to the pastures. Since the greatest accumulation of larvae occurs in the lower parts of the sward (90% occurs below 10 cm, SYKES, 1987), the chance for the animals grazing GM3 to ingest the parasite larvae might be less than for GM1 and GM2 although, when moisture is adequate, parasite larvae should be able to travel up to the higher parts of the forage.

Table 4. Worm burdens of tracer animals grazing pastures previously grazed by lambs infected with *Haemonchus contortus* under three grazing management systems

Treatment[a]	Worm Counts			
	n[b]	Mean	Range	SE
GM1	4	78	10 - 100	36
GM2	4	258	140 - 400	71
GM3	4	33	0 - 70	19
MSD[c]		158		

[a]GM1=Two pastures in which one was grazed by animals for six weeks and then rested for six weeks
GM2=Seven pastures in which one was grazed by animals for one week and then rested for six week
GM3=Two pastures in which one was grazed by animals for twelve weeks and then rested for twelve weeks
[b]Number of observation (pasture basis)
[c]MSD=Waller - Duncan minimum significant difference

Effect of concentrate supplementation

Fecal egg counts, PCV and serum protein

Levels of supplementation had a significant effect (P<0.001) on the fecal egg counts for both the Sumatra and St. Croix crosses (Table 5). A supplement x genotype interaction was significant (P<0.01) which was attributed to a disproportionate difference between the two genotypes on the low and high supplement treatments. On the low supplement, fecal egg numbers in Sumatra and St.Croix crosses did not differ (P>0.1), but on the high supplement the St. Croix crosses had lower (P<0.01) fecal egg numbers.

GATENBY and BATUBARA (1994) have summarized the mean fecal egg counts in lambs and young females before given anthelmintic treatment in North Sumatra and concluded that the animals were moderately infected with mean fecal egg counts of 760 epg. Based on this figure, it is suspected that the animals on the low supplement of both genotypes were highly infected with *Haemonchus contortus*.

Although the fecal egg counts of animals on the high supplement were significantly lower (P<0.001) than for the low supplement, the Sumatra lambs seemed to remain susceptible to infection (2,006 epg), while the St. Croix crosses maintained egg counts (977 epg) close to the moderate level (760 epg). This findings agree with ROMJALI (1995) who analysed egg count data of weaned lambs over 11 lambing periods and found that the St. Croix crosses had lower fecal egg numbers than the Sumatra.

Lambs of Sumatera and St. Croix crosses fed the high supplement had greater (P<0.001) PCV values than lambs fed the low supplement (Table 5). Genotype effects were significant (P<0.001). The Sumatra lambs had lower PCV than the St. Croix crosses on both the low and the high supplement.

The PCV levels of both Sumatra (20.9%) and St.Croix crosses (21.6%) fed the low supplement were close to the normal threshold of 22% reported by BLOOD and RADOSTITS (1989). The PCV values increased to above normal threshold level on the high supplement. The review by GATENBY and BATUBARA (1994) suggested that young lambs and ewes with mean PCV value of 28% were moderately infected with gastrointestinal parasites. This agreed closely with the PCV value and fecal egg counts of the St. Croix crossbred lambs fed the high supplement in the present study.

Lambs fed the high supplement had greater (P<0.001) total serum protein than those fed the low supplement (Table 5). The serum protein level of the St.Croix crosses on the low supplement was not different from Sumatra, but on the high supplement, the St. Croix crosses had a higher (P<0.001) serum protein than the Sumatra. The increases in total serum protein in both groups as supplementation level rose agrees with the findings of BLACKBURN *et al.* (1991) for kids infected with *Haemonchus contortus*. Total serum protein in both groups, however, were below the minimum normal value of 6.0 g/dl (BLOOD and RADOSTITS, 1989), which support the conclusion that these animals were moderately or highly infected with the *Haemonchus* larvae.

Table 5. Fecal egg counts, PCV and total serum protein (mean ±SE) from St Croix crosses and Sumatra lambs infected with *Haemonchus contortus* when given supplements at low or high level

Breed	Supplement[a]	EPG	PCV (%)	Serum Protein (g/dl)
St. Croix (HC)	Low (L)	5725± 394	21.6± 0.32	4.72± 0.04
Sumatera (S)	Low (L)	5313± 424	20.9± 0.34	4.80± 0.05
St Croix (HC)	High (H)	977± 313	25.9± 0.28	5.29± 0.04
Sumatera (S)	High (H)	2006± 338	25.0± 0.28	5.04± 0.04
MSD[b]		870	0.7	0.10
Contrast :				
L vs. H		0.0001	0.0063	0.0001
HC vs. S		0.4049	0.0001	0.1380
LH vs. SHC		0.0518	0.0001	0.0001

[a]Low: Fed supplements at 0.5% BW; High: Fed supplements at 1.6% BW
[b]MSD=Waller-Duncan minimum significant difference

Feed intake and liveweight gain

Forage dry matter intake (g/kg BW/d) was greater (P<0.01) on the low supplement group than on the highly supplemented lambs (Table 6). The total dry matter intake, however, was not different (P>0.10) between the high and the low supplement groups. On the low supplement group, the forage comprised of approximately 89% of total intake, while on the high supplement treatment, it comprised of approximately 65%. The magnitude of effects of parasite on the intake was influenced by the level of parasite infestation in the animals (BLACKBURN *et al.*, 1991). In the present study, even at mean fecal egg counts of 5,300 in the Sumatra lambs or 5,800 in the St. Croix crosses (both on the low supplement group), the effects of parasite infection on the feed intake was not detected.

As expected, lambs of both genotypes on the high supplement treatment had higher ADG (P<0.001) than on the low supplement group (Table 6). Although supplement x genotype interaction effects were noted (P= 0.0554), they were not important because they resulted from a magnitude of differences between levels of supplement and not due to a shift in ranks.

Lamb ADG, particularly on the 0.5% BW supplement, were abnormaly low. The ADG of 38 to 44 g/d have been previously reported for Sumatra or St.Croix crosses when given 0.5% BW feed supplement (SIMANIHURUK *et al.*, 1994). Gains of sheep receiving supplement at 1.6% BW were also less than expected, especially when compared to the ADG of weaned Sumatra of 103 g/d as recorded by SANCHEZ and BOER (1988) or ADG of St. Croix crossbred lambs ranging from 81 g/d (SANCHEZ, 1989) to 161 g/d (POND *et al.*, 1994). The low ADG could be indicative of heavy *Haemonchus* infection which may depress the rate of gain. Also, in the present study, gains were measured in the lambs over a long period covering the animal ages from 3 to 11 months. This length of time may have slightly lowered the overall mean gains compared to the figures cited above, which were obtained when gains were measured during the period of fastest growth (3 months post weaning).

Table 6. Daily gain, intake and fecal output of Sumatra lambs and St croix crosses given low or high supplement and infected with *Haemonchus contortus*

Breed	Supplement[a]	Fecal Output (g DM/kg/ BW)	Forages Intake[b] (g DM/kg BW)	Total Intake[c] (g DM/kg BW)	ADG (g)
St. Croix (HC)	Low (L)	13 ± 0.49	35 ± 0.89	40 ± 0.95	8.3 ± 5.4
Sumatera (S)	Low (L)	14 ± 0.56	35 ± 0.84	40 ± 0.89	8.1 ± 5.8
St. Croix (HC)	High (H)	14 ± 0.42	29 ± 0.89	45 ± 0.99	70.1 ± 4.3
Sumatera (S)	High (H)	15 ± 0.61	29 ± 0.98	44 ± 1.04	50.3 ± 4.6
MSD[d]		NS	5.6	NS	12.4
Contrast :					
L vs. H		0.8976	0.0003	0.2343	0.0001
HC vs. S		0.9167	0.9346	0.5119	0.0507
LH vs. SHC		0.7745	0.3452	0.2929	0.0554

[a]Low=Lambs were given supplement at 0.5% BW; High=Lambs were given supplement at 1.6% BW
[b]Dry matter intake was estimated using IVDMD values from hand-plucked samples from GM1, GM2 and GM3
[c]Total intake=Forage intake + Supplement intake (16 g/kg BW on the high supplement group or 5.0 g/kg BW on the low supplement group)
[d]Waller-Duncan minimum significant difference

CONCLUSION

A six-week grazing and a six-week resting system (GM1) resulted in the most rapidly increasing parasite contamination on the pasture resulting in the necessity to use anthelmintic treatment at week 18 after infection. A 12-week grazing and a 12-week resting system (GM3) did not totally eliminate the larvae population on pastures, and anthelmintic treatment was required, although its use was delayed by 8 weeks relative to GM1. A one-week grazing and a six-week resting system (GM2) seemed to be superior than GM1 or GM3, since no anthelmintics is required during the period of the experiment. The Sumatra and St. Croix crosses responded similarly to low supplement, but when supplemented at high level, the St Croix crosses were better able to withstand the parasitism as indicated by the lower egg counts and higher PCV and serum protein. It is suggested that the level of worm burden and its consequences on the performance of grazing lambs can be depressed by improving the nutritional status of the lambs. Programme that integrates the grazing management, nutrition and partial use of anthelmintics is recommended in controlling the establishment and development of parasites in grazing sheep.

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