The effect of integrated grazing of goats, sheep and cattle on animal productivity and health on high-producing hill country pastures.

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ABSTRACT

An experiment ran from mid-October to mid-January to develop pasture height/quality guidelines for optimum doe and kid growth in spring and to test the advantages of integrating goats with other stock classes at this time. Three goat-only farmlets comprised two paddocks with does and kids alternating, 7 days in each. Pre-grazing pasture mass was maintained at 1.6, 2.0 and 2.5 t DM/ha respectively. In three integrated-species farmlets, does with kids grazed from a pre-graze pasture mass of 2.5 t DM/ha for 7 days, followed by the sheep/cattle mob for 7 days. Paddocks were spelled for three weeks before goats were reintroduced. Sheep/cattle mobs comprised, hoggets, yearling steers, or 60%/40% combination of the two (respectively). In goat-only farmlets, does lost live weight and kid liveweight gain was reduced when pre-graze pasture mass was below 2.5 t DM/ha. Doe liveweight gain was maximised in the goat/sheep/cattle farmlet. Kid liveweight gain was compromised only on the lowest pasture mass, gain on other farmlets being similar. Sheep and cattle liveweight gains appeared to be unaffected by grazing behind goats when grazing down to 1.5 - 1.6 t DM/ha. Parasite faecal egg concentration (FEC) of does was increased by grazing at low pasture masses with 80% and 63% of does being drenched at 1.6 and 2.0 t DM/ha respectively compared to 53 % at 2.5 t DM/ha. Integration with cattle and sheep/cattle reduced FEC (27% and 17% does drenched respectively) compared with goats only or goats followed by sheep (53% and 43% respectively). In all farmlets without sheep grazing, weed occurrence on transect analysis was over 35%. The presence of sheep reduced this to approx 23% and in the goat/sheep/cattle system weed occurrence was approx 10%. Clover occurrence was similar in all farmlets (approx 50%) except for the goat/sheep farmlet (approx 30%).

Keywords Integrated grazing; goat; sheep; cattle; pasture mass; weeds; pasture quality; internal parasites; drenching

INTRODUCTION

Recent work in New Zealand has revealed that goats perform well solely on pasture diets if offered adequate amounts. Performance of goats on pasture is related to pasture quality; liveweight gains are highest when the percentage of green matter in the pasture is highest (McCall and Lambert, 1987). Goats preferentially graze green pasture from the top of the sward and liveweight gain is very sensitive to the height of pasture being grazed (McCall and Fitzgerald, 1987; Nicol *et al.*, 1987a). An efficient grazing strategy for does and kids needs to optimise animal performance in terms of pasture height and pasture quality. The main problem is how to provide tall, high-quality feed to achieve high goat performance in spring and early summer.

In goat-only grazing systems, late September kidding allows time for a sufficient length of pasture to accumulate to allow high performance of does and kids. However, it is usually not possible to maintain the feed quality throughout the Spring period (McCall and Lambert, 1987). On many hill country farms in New Zealand, sheep and cattle are available for use as "pasture conditioners" to ensure that tall, high-quality feed is available at this time. Ewe hoggets, growing cattle or cows and calves may be available to condition pastures for does and kids by following them in a grazing rotation. There would be little effect on sheep and cattle performance if appropriate guidelines for their management were followed (Sheath *et al.*, 1984; McCall *et al.*, 1986).

However, there are important animal health

consequences for grazing goats with other classes of livestock. Goats and sheep are susceptible to common intestinal parasites and Watson (pers. comm.) has found an inverse relationship between the average height of pasture grazed and faecal parasite egg concentration in buck hoggets. It is important to balance the positive aspects of using other stock to provide tall, quality pasture with possible negative aspects of increased risk of intestinal parasitism.

In the Spring of 1987 an experiment was run at Whatawhata Research Centre to examine the effect of pasture height and quality on doe and kid performance and to determine the effect of integrating goats with other stock classes during this period.

MATERIALS AND METHODS

Trial Design

The experiment ran for 12 weeks from mid-October 1987 to mid-January 1988. Three goat-only farmlets and three integrated species farmlets were established. The goat-only farmlets comprised two paddocks (total area approximately 1.5 ha) between which lactating cashmere does (n=30) and their kids alternated at weekly intervals. Pre-grazing pasture mass was maintained at 1600, 2000 and 2500 kg DM/ha respectively by introducing or withdrawing additional buffer animals (does) as necessary. The integrated species farmlets comprised five paddocks (total area approximately 5 ha) in which does (n=30) and their kids grazed from a pre-graze pasture mass of 2500 kg DM/h for 7 days, followed by a conditioner mob for 7 days. Paddocks were then spelled for three weeks before the goats were reintroduced. Pasture mass before grazing by goats was maintained by introduction or withdrawal of additional conditioner animals as necessary. Conditioner mobs comprised ewe hoggets (n=60 approx.), yearling steers (n=14 approx.) or 60%:40% combination of the two (on a stock unit basis; n=53:n=8 respectively). Animals were drenched before the trial with ivermectin (200μg/kg live weight).

Measurements

All animals were weighed at 4-week intervals. Rectal faecal samples were taken from all does at two week intervals and analysed immediately for faecal parasite egg concentration. Individual does were drenched (ivermectin; 200μg/kg live weight) when their faecal egg count reached 1000 eggs per gram fresh faeces. Because of extreme difficulty obtaining faecal samples from young kids, all kids were drenched at two-week intervals to suppress parasitism.

Pasture mass was assessed before and after grazing by goats and after grazing by conditioners. Pasture mass was estimated by calibrated visual assessment (Haydock and Shaw, 1975) of a minimum of 30 random quadrats (0.1m^2) in each paddock. Pasture quality throughout the experiment was assessed by botanical dissection of representative herbage samples plucked from each quadrat assessed above, combined within paddocks. Components dissected were green grass leaf, sheath, stem; green clover leaf,stolon; green weeds; dead grass stem; dead remainder.

On conclusion of the experiment, pasture composition in the experimental areas was assessed by point transect analysis along five 20 metre transects laid out in two paddocks from each farmlet. Pasture composition was assessed at 0.5m intervals along each transect (40 points per transect, 200 points per paddock) for presence of grass clover or weeds at each point. Transects were read one week after being grazed (by goats in the goat-only farmlets and by conditioners in the integrated species farmlets).

RESULTS

In the goat-only farmlets, pasture mass had a considerable effect on liveweight gain over the 12 weeks of the experiment (Table 1.). Does lost live weight at pasture masses below 2500 kg DM/ha. Kid liveweight gain, though buffered to some extent by the lactating does, was reduced on the lower pasture allowances. On the integrated species farmlets, the highest liveweight gains of does were observed on the goat/sheep/cattle farmlet. Kid

liveweight gain was highest on the goat/cattle farmlet. For both does and kids the lowest liveweight gains were observed on the goat/sheep farmlet. Sheep and cattle liveweight gains were similar between farmlets and similar to those reported by McCall *et al.* (1986) in sheep only, cattle only and sheep/cattle farmlets.

TABLE 1 Liveweight gains of goats, sheep and cattle on goat-only farmlets and integrated species farmlets (g/d).

Treatment	Does	Kids	Sheep	Cattle
Goats only:				
1600 kg DM/ha	-14	54	-	-
2000 kg DM/ha	-5	71	-	-
2500 kg DM/ha	15	81	-	-
Goats followed by:				
Sheep	12	78	80	-
Sheep/cattle	26	81	94	900
Cattle	17	92	-	904
SED	5.2	4.7	9.8	5.0

TABLE 2 Percentage of does drenched on goat-only farmlets and integrated species farmlets (%).

Treatment	Drenched at least once	Drenched twice
Goats only:		
1600 kg DM/ha	80	30
2000 kg DM/ha	63	10
2500 kg DM/ha	53	0
Goats followed by:		
Sheep	43	0
Sheep/cattle	17	3
Cattle	27	3

In goat-only farmlets both the incidence and frequency of doe drenching was inversely related to pasture mass (Table 2). In the integrated species farmlets, the lowest incidence of drenching was observed in the goat/sheep/cattle farmlet and the highest in the goat/sheep farmlet (Table 2). There was no difference in the incidence of multiple drenching in the integrated species farmlets.

From pasture samples sorted into botanical components during the experiment the proportions of green grass, clover, weeds and dead material were estimated (Table 3). Figures for the goat-only farmlets are the mean differences in percentage composition of the two paddocks in each farmlet between the beginning and end of the experiment (12 weeks). No SED values were calculated for these values. Figures for the integrated species are the mean of the difference in percentage composition of the five paddocks in each farmlet between the first and second complete rotations (5 weeks). In goat-only farmlets, clover and weed content of the pastures increased by approximately 15% over the experiment. Green grass content of the pastures declined, more so at the higher pasture mass. Dead matter content of pasture under the highest pasture mass increased over the experiment whereas at the lowest mass, dead matter percentage decreased. In comparison the rate of change of pasture composition in integrated species farmlets was very slow with little difference in composition between the first and second rotations.

TABLE 3 Change in percentage of botanical components in pastures grazed by goats only or by goats followed by sheep and/or cattle (%).

Treatment	Green grass	Clover	Weeds	Dead matter
Goats only:				
1600 kg DM/ha	-15.9	13.8	12.1	-10.1
2000 kg DM/ha	-41.9	19.0	14.1	-8.5
2500 kg DM/ha	-54.1	17.6	11.4	25.0
SED (see text)	-	-	-	-
Goats followed by:				
Sheep	-13.6	3.0	2.4	8.2
Sheep/cattle	-5.8	-2.7	1.7	6.8
Cattle	-8.0	-3.8	6.1	5.8
SED	4.8	4.4	4.7	5.4

Table 4 shows a direct comparison between farmlets in the percentage of transect points at which clover and weeds were observed at the end of the experiment. Since grass was observed at almost all transect points, these data are omitted for clarity of presentation. There was no overall difference between farmlets in the occurrence of

clover in the pastures except that in the goat/sheep farmlet, less clover was observed than in the goat-only farmlets. Weed occurrence was greatest in farmlets without sheep grazing. In the goat/sheep farmlet weed occurrence was very low compared to all other farmlets.

TABLE 4 Percentage points on the transects where clover and weeds were present in pastures grazed by goats only or by goats followed by sheep and/or cattle (%).

Treatment	Clover	Weeds
Goats only:		
1600 kg DM/ha	55.8	40.8
2000 kg DM/ha	57.8	60.8
2500 kg DM/ha	46.3	40.5
Goats followed by:		
Sheep	28.5	23.0
Sheep/cattle	39.8	9.5
Cattle	42.0	38.5
SED	10.2	6.5

N.B. Because both clover and weeds were present at some transect points, combined percentages do not equal 100%

DISCUSSION

The results of this experiment confirm that pasture height has an important influence in goat productivity in a goat-only grazing system (McCall and Lambert, 1987). Collins and Nicol (1986) suggested that this resulted from a reduction in voluntary feed intake at lower pasture mass. Conditioning pasture with other stock classes, particularly the sheep/cattle mob, gave further increases in goat performance by increasing the percentage of green content of tall pasture on offer to the goats. Prolonged grazing of only goats on tall pasture was associated with an increase in the amount of dead matter present in the pasture (Table 3) in agreement with the study of Hughes et al. (1984) in which goats grazing pasture were observed to actively reject dead matter. However, the reduction in dead material in the pasture at the lower pasture mass suggests that as the proportion of green grass (the preferred feed) in the sward diminished goats ate more dead material rather than clover or herb weeds. This apparently contradicts the findings of Nicol *et al.* (1987b) in which goats' diet varied little with declining pasture mass with only a small substitution of grass stem for green leaf and very little increase in dead matter intake. However, the technique adopted in the present study was not as precise as that reported by Nicol *et al.* (1987b) for estimating the quality of the goats' dietary intake.

The results in Table 4 appear to confirm the proliferation of weeds in the goat-only grazed pastures which was suggested by Table 3. In addition, the data show a general proliferation of clover and weeds in the integrated species farmlets. This could not be confidently predicted from Table 3 which shows the effects on pasture composition of 2 grazings. Presence of sheep in the farmlet appears to have reduced the clover and weed proportions in the pasture over the experiment compared to the goat only and goat/cattle farmlets (Table 4) probably because of preferential grazing of clover by the sheep and their grazing habit which damages clover stolons.

The results of this experiment are also in agreement with Watson (pers. comm.) in demonstrating an inverse relationship between pasture height and parasitic challenge to goats (Table 2). This is, perhaps, not surprising because most of the parasite larval population lies within 3 cm of the soil surface (Vlassoff, 1982). Therefore goats grazing shorter pastures will have a greater opportunity to ingest infective larvae.

In the integrated species farmlets, the sheep conditioner mob appears to have conferred a greater risk of parasitism to the goats than cattle. Almost half the goats required drenching before the end of the experiment. The presence of cattle with sheep in the farmlet appeared to reduce the risk of parasitism in goats. This may be associated with the ability of cattle to "mop up" a proportion of the parasite larvae without suffering the effects of parasitism (Porter, 1953; Nicol and Thompson, 1982). This, together with the high (i.e. tall) pasture allowance (i.e. 2500 kg DM/ha = 8 to 10cm approx.) in the integrated species farmlets, combined to further reduce the parasitic challenge to the goats by allowing the goats to avoid the majority of the parasite burden in the base of the sward.

CONCLUSION

Under Whatawhata hill country conditions (at least) a grazing rotation in which a mixed mob of sheep and cattle were grazed behind does and their kids appeared to be the most successful system for optimising doe and kid performance without compromising sheep and cattle performance. It also minimised the risk of parasitism to the goats. This appeared to be a function of the maintenance of tall, good-quality feed for goats under this system.

The maximum ratio of goats to the conditioner stock classes under which goat, sheep and cattle performance are optimised is not yet known.

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