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Performance and productivity per unit area of Cashmere goats managed at three stocking rates in improved upland pastures of northern Spain

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Abstract. Grazing management decisions such as the choice of stocking rate (SR) may have strong implications on extensive goat production systems. In this trial, the effects of three SR, high (HSR, 20 goats/ha), medium (MSR, 15 goats/ha) and low (LSR, 10 goats/ha), on productive performance of grazing Cashmere goats were studied during three grazing seasons in improved upland pastures of northern Spain. Treatments were replicated twice on six plots sown with *Lolium perenne* and *Trifolium repens*, and with a high presence of the native grass *Agrostis capillaris*. Body weight (BW) and body condition score (BCS) of goats were periodically monitored. No notable differences between treatments were found in pasture botanical composition and nutritive quality. The higher mean sward heights at lower SR resulted in more favourable goats' BW and BCS changes in LSR than in MSR and HSR (-14, -29, -52 g/day, respectively; $P < 0.001$). Greater individual BW gains of kids were observed in LSR and MSR (94 g/day) compared to HSR (70 g/day; $P < 0.05$). Inversely, kids' daily BW gains per hectare were greater ($P < 0.001$) in HSR and MSR (1.37 kg/day/ha) compared to LSR (0.98 kg/day/ha). Adding BW changes of dams and offspring, overall productivity was higher in MSR and LSR than in HSR (864 vs 375 g/day/ha; $P < 0.01$). A medium SR of 15 goats/ha could represent a better balance between individual goat performance, subsequent BW and BCS recovery in breeding females, and productivity per unit land area in these pastures.

Keywords. Stocking rate – Meat production – Goat – Grazing pressure.

Performances et productivité par unité de surface pour des chèvres Cachemire conduites en trois taux de chargement dans des pâturages d'altitude améliorés du nord de l'Espagne

Résumé. Les décisions de gestion du pâturage telles que le choix du taux de chargement (SR) peuvent avoir de fortes implications sur les systèmes extensifs de production caprine. Cet essai a étudié les effets de trois taux de chargement, fort (HSR, 20 chèvres/ha), moyen (MSR, 15 chèvres/ha) et faible (LSR, 10 chèvres/ha), sur les performances productives de chèvres Cachemire en pacage durant trois saisons de pâturage dans des prairies d'altitude améliorées du nord de l'Espagne. Les traitements ont été répétés deux fois sur six parcelles semées de *Lolium perenne* et *Trifolium repens*, avec une forte présence de la plante autochtone *Agrostis capillaris*. Le poids corporel (BW) et la note d'état corporel (BCS) des chèvres ont été suivis périodiquement. Aucune différence notable n'a été trouvée entre traitements pour la composition botanique de la prairie et la qualité nutritive. Les plus fortes hauteurs moyennes des prairies pour le taux de chargement plus faible ont résulté en changements plus favorables du poids corporel et de la note d'état corporel des chèvres pour LSR par rapport à MSR et HSR (-14, -29, -52 g/jour, respectivement; $P < 0,001$). Des gains plus élevés de poids corporel des chevreaux ont été observés pour LSR et MSR (94 g/jour) comparés à HSR (70 g/jour; $P < 0,05$). Inversement, le GMQ des chevreaux par hectare a été supérieur ($P < 0,001$) pour HSR et MSR (1,37 kg/jour/ha) comparé à LSR (0,98 kg/jour/ha). Si l'on additionne les changements de poids corporel des mères et des jeunes, la productivité globale était supérieure pour MSR et LSR par rapport à HSR (864 vs 375 g/jour/ha; $P < 0,01$). Un taux de chargement moyen de 15 chèvres/ha pourrait représenter un meilleur équilibre entre les performances individuelles des caprins, le poids corporel subséquent et la récupération de note d'état corporel chez les femelles reproductrices, et la productivité par unité de surface sur ces pâturages.

Mots-clés. Taux de chargement – Production de viande – Caprins – Pression de pâturage.

I – Introduction

Pasture improvement is usually carried out in northern Spanish uplands in areas where natural vegetation offers little opportunities for the development of sustainable grazing systems. Improved pastures provide quality herbage to better meet the nutritional requirements of livestock. Goat meat production may be a good option as an alternative to other livestock in these pastures. Cashmere goats have been proven to graze efficiently on grass-legume pastures to produce highly appreciated meat and fibre (Merchant and Riach, 1994; Osoro and Martínez, 1995). However, few studies have been performed to examine the effects of different grazing managements on their production potential.

Stocking rate (SR) is a key factor that affects grazing pressure, herbage allowance, animal intake and production. In general, SR is negatively related to individual animal performance, and positively to output per unit land area (Radcliffe *et al.*, 1991; Animut *et al.*, 2005). However, a too high grazing pressure may lead to an herbage shortage leading to malnutrition and starvation of animals. Studies are needed to elucidate the optimum SR that benefits both animal production and pasture maintenance. The objective of this work was to study and compare Cashmere goat performance and productivity per unit land area under three SR treatments (20, 15 or 10 goats/ha) when grazing on improved upland pastures.

II – Material and methods

1. Study site and experimental design

The study was performed at Carbayal Research Station located at 800-1000 m a.s.l. in Illano, western Asturias, northern Spain (43° 20' N, 6° 53' W). Soils are acid and nutrient poor. Improved pasture was established by means of mechanical brush clearing, soil ploughing, fertilization with lime and NPK, and sowing perennial ryegrass (*Lolium perenne* cv Phoenix), hybrid ryegrass (*Lolium x hybridum* cv Dalita) and white clover (*Trifolium repens* cv Huia).

Three SR treatments were examined: high (HSR; 20 goats/ha), medium (MSR; 15 goats/ha) and low (LSR; 10 goats/ha). Two replicates (plots) per treatment were established. The six plots comprised 0.3, 0.6 or 0.9 ha for HSR, MSR and LSR, respectively. During the three years of the experiment (2010, 2011 and 2012), six goats (does with their kids) per plot were managed in HSR, and nine per plot in MSR and LSR. All goats were Cashmere breed. Grazing season extended from late April to October, except in 2012 (till mid September). Does grazed with their kids (born during March-April) until weaning in July. Before the start of the grazing season, animals were dewormed with a commercial anthelmintic.

2. Measurements

Herbage allowance was assessed by measuring the sward surface height (SSH) every two weeks at 100 random hits per plot. Botanical composition was annually recorded at 250 vertical hits per plot with a point quadrat. Herbage samples were collected at early summer and early autumn for bromatological analysis following standard procedures.

Animals were weighed and body condition score (BCS) of does assessed on a scale of 1-5 (Ruszel, 1990) at turn-out, at weaning and at the end of the grazing season. Daily body weight (BW) changes and BCS changes were calculated for the different periods (i.e. pre-wean and post-wean) and for the whole grazing season. Output per hectare, daily kids' BW gains per hectare and total productivity per hectare (adding BW changes of dams and offspring) were calculated for each experimental plot.

3. Statistical analyses

Individual animals' BW and BCS changes were subjected to a mixed model ANOVA to test the fixed effects of SR, year (Y) and SR×Y, including the random effect of plot (nested within SR), and initial BW or BCS as covariates. Production variables per unit area were analysed for SR, Y and SR×Y effects, with plots as experimental units ($n = 2$). Tukey test was used for comparisons between pairs of means.

III – Results and discussion

1. Available vegetation

Herbage allowance was affected by SR, with mean SSH across years and periods of 9.6, 11.5 and 14.4 cm in HSR, MSR and LSR, respectively ($P < 0.001$). Mean SSH was higher in 2012 than in 2010 and 2011, and during pre-wean compared to post-weaning (13.0 vs 10.7 cm; $P < 0.001$). Pasture botanical composition was not much affected by SR regarding the green (live) components. Cover percentages of perennial ryegrass and white clover decreased during the experiment while *A. capillaris* became the dominant species. The percentage of dead matter increased more markedly across years in LSR plots ($P < 0.05$). Herbage nutritive quality decreased from early summer to autumn, with scarce differences between treatments.

2. Animal performance

During the pre-weaning period, lactating goats showed a worse performance in HSR than in MSR and LSR in terms of both BW and BCS changes. After weaning, a better performance of goats was observed in LSR compared to HSR and MSR. For the whole grazing season, goat performance linearly decreased with increasing SR (Table 1). In general, these results agree with other studies in herbaceous pastures (Radcliffe *et al.*, 1991; Yiakoulaki *et al.*, 2007). Goats are known to graze preferentially on the sward surface (Milne, 1991), and their intake and performance are positively related with available SSH (Merchant and Riach, 1994; Osoro and Martínez, 1995). However, some studies (e.g. Animut *et al.*, 2005; Askar *et al.*, 2013) found lower differences in goat BW changes between different SR treatments, possibly related to high available herbage biomasses not limiting intake. In our study, apart from the reduced intake, goats in HSR would be more prejudiced due to higher levels of parasitic infections, as indicated by faecal nematode egg counts (unpublished data).

Table 1. Body weight (BW) and body condition score (BCS) changes of Cashmere goats grazing upland pastures at three stocking rates (HSR: 20 goats/ha; MSR: 15 goats/ha; LSR: 10 goats/ha) during three study years

SR treatment	HSR	MSR	LSR	SEM	SR	Year	SR×Y	Cov.†
Initial BW (kg)	37.4	38.1	37.8	0.88	NS	*	NS	–
Initial BCS (scale 1-5)	2.62	2.53	2.51	0.06	NS	**	NS	–
Pre-wean BW change (g/day)	-44.1 ^b	-4.9 ^a	4.2 ^a	5.98	***	**	NS	***
Pre-wean BCS change	-0.14 ^b	0.10 ^a	0.14 ^a	0.04	*	**	NS	***
Post-wean BW change (g/day)	-60.0 ^b	-48.8 ^b	-28.3 ^a	7.02	*	*	NS	**
Post-wean BCS change	-0.53 ^b	-0.45 ^b	-0.23 ^a	0.05	*	*	NS	NS
Overall BW change (g/day)	-51.6 ^c	-29.5 ^b	-13.8 ^a	4.57	***	NS	NS	***
Overall BCS change	-0.63 ^c	-0.34 ^b	-0.08 ^a	0.06	*	NS	NS	***

† Covariate effects of initial BW or BCS.

Kids presented greater BW gains in LSR and MSR than in HSR (94 vs 70 g/day), leading to greater final BW at weaning in LSR than in HSR ($P<0.05$; Table 2). Inversely, final BW per unit area was greater in HSR than in MSR and LSR, while greater BW gains per unit area from turn-out to weaning were found in HSR and MSR compared to LSR ($P<0.001$). Greater daily BW gains per hectare were obtained in HSR and MSR compared to LSR (1.37 vs 0.98 kg/day/ha; $P<0.001$). Total productivity per unit area (adding BW changes of does and kids) was higher in MSR and LSR than in HSR (885, 844 and 375 g/day/ha, respectively; $P<0.01$).

Table 2. Body weight (BW) gains and final BW at weaning per animal and per unit area of Cashmere goat kids grazing upland pastures at three stocking rates (HSR: 20 goats/ha; MSR: 15 goats/ha; LSR: 10 goats/ha) during three study years

SR treatment	HSR	MSR	LSR	SEM	SR	Year	SR×Y
Initial BW (kg)	10.6	10.4	11.7	0.53	NS	**	NS
Daily BW gain (g/day)	70.4 ^b	89.1 ^a	98.2 ^a	4.87	*	**	*
Final BW at weaning (kg)	16.0 ^b	17.2 ^{ab}	19.2 ^a	0.59	*	NS	NS
Final BW per area (kg/ha)	320 ^a	258 ^b	192 ^c	9.18	***	NS	NS
BW gain per area (kg/ha)	108 ^a	102 ^a	75 ^b	3.74	***	***	*
Daily BW gain per area (kg/day/ha)	1.41 ^a	1.34 ^a	0.98 ^b	0.05	***	**	NS

* $P<0.05$; ** $P<0.01$; *** $P<0.001$.

IV – Conclusions

Results indicate that a medium SR of 15 goats/ha could represent a better balance between individual goat performance, welfare, subsequent BW and BCS recovery in breeding females to bring next progeny, and productivity per unit land area in upland improved pastures.

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References

- Animut G., Goetsch A.L., Aiken G.E., Puchala R., Detweiler G., Krehbiel C.R., Merkel R.C., Sahlu T., Dawson L.J., Johnson Z.B. and Gipson T.A., 2005. Performance and forage selectivity of sheep and goats co-grazing grass/forb pastures at three stocking rates. In: *Small Ruminant Research*, 59, p. 203-215.
- Askar A.R., Gipson T.A., Puchala R., Tesfai K., Detweiler G.D., Asmare A., Keli A., Sahlu T. and Goetsch A.L., 2013. Effects of stocking rate and physiological state of meat goats grazing grass/forb pastures on forage intake, selection, and digestion, grazing behavior, and performance. In: *Livestock Science*, 154, p. 82-92.
- Merchant M. and Riach D.J., 1994. The intake and performance of cashmere goats grazing sown swards. In: *Grass and Forage Science*, 49, p. 429-437.
- Milne J.A., 1991. Diet selection by grazing animals. In: *Proceedings of the Nutrition Society*, 50, p. 77-85.
- Osoro K. and Martínez A., 1995. Grazing behaviour and performance of goats and sheep on natural and improved vegetation. In: Laker J.P., Russel A.J.F. (eds). *The nutrition and grazing ecology of speciality fibre producing animals*. Aberdeen, Scotland, UK: MLURI, European Fine Fibre Network, p. 109-125.
- Radcliffe J.E., Townsend R.J. and Baird D.B., 1991. Mixed and separate grazing of sheep and goats at two stocking rates. In: *New Zealand Journal of Agricultural Research*, 34, p. 167-176.
- Russel A.J.F., 1990. Body condition scoring of goats. In: *Scottish Cashmere Producers Association Newsletter*, 10, p. 3.
- Yiakoulaki M.D., Goetsch A.L., Detweiler G. and Sahlu T., 2007. Effects of stocking rate and creep grazing on performance by Spanish and Boer × Spanish does with crossbred Boer kids. In: *Small Ruminant Research*, 71, p. 234-242.