Responses by dairy ewes to different sward heights under continuous stocking either unsupplemented or supplemented with corn grain

Molle G., Ligios S., Fois N., Decandia M., Casu S., Bomboi G.

in

Lindberg J.E. (ed.), Gonda H.L. (ed.), Ledin I. (ed.).
Recent advances in small ruminant nutrition

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 34

1997
pages 65-70

Responses by dairy ewes to different sward heights under continuous stocking either unsupplemented or supplemented with corn grain

G. Molle*, S. Ligios*, N. Fois*, M. Decandia*, S. Casu* and G. Bomboi**
*Istituto Zootecnico e Caseario per la Sardegna, 07040 Olmedo, Italy
**Dipartimento di Biologia Animale, 07100 Sassari, Italy

SUMMARY - Two experiments (E1, in early lactation and E2, in middle lactation) were carried out on seventy-two Sarda ewes continuously grazing Italian ryegrass (*Lolium multiflorum* Lam.). The ewes were divided into three groups allotted to paddocks maintained at different sward heights (SHs, 20, 40 and 60 mm in E1 and 30, 60 and 90 mm in E2). The groups were in turn split into subgroups, receiving either nil or 500 g/d of whole corn grain. Herbage intake (HI) was limited ($P<0.01$) by SHs lower than 40 mm (E1) and 60 mm (E2). In both trials HI was lower in the supplemented than in the unsupplemented ewes ($P<0.01$). Milk yield (MY) was reduced by low SHs (20 mm in E1 and 30 mm in E2, $P<0.05$). The supplement had a positive effect on MY ($P<0.05$) only in E1. Significant effects ($P<0.05$) were also found of the factors or their interaction on changes in body weight and condition score (E1 and E2) and on plasma glucose and non-esterified fatty acids (E2). It is concluded that during both early and mid-lactation SHs lower than 60 mm can limit intake and performance of dairy ewes continuously grazing Italian ryegrass. Supplementation with corn grain partially compensates for low HI in early but not in mid-lactation.

Key words: Milk yield, continuous grazing, supplementation, dairy ewes.

RESUME - *"Réponses des brebis laitières en pâture permanente à différentes hauteurs d'herbe avec ou sans supplémentation de grain de maïs". Deux expériences (E1, en début de lactation et E2, à mi-lactation) ont été menées sur 72 brebis de race Sarde en pâturage permanent sur du ray-grass italien* (Lolium multiflorum *Lam.*). *Les brebis ont été divisées en trois groupes et mises sur des prairies maintenues à différentes hauteurs d'herbe (20, 40 et 60 mm dans E1 et 30, 60 et 90 mm dans E2). Les groupes ont été à leur tour subdivisés en sous-groupes, ne recevant rien ou soit 500 g/d de grain complet de maïs. L'ingestion d'herbage était limitée ($P<0,01$) par des hauteurs d'herbe inférieures à 40 mm (E1) et 60 mm (E2). Dans les deux essais l'ingestion d'herbage était plus faible chez les brebis supplémentées par rapport aux brebis non supplémentées ($P<0,01$). Le rendement laitier était réduit par une faible hauteur d'herbe (20 mm dans E1 et 30 mm dans E2, $P<0,05$). Le supplément avait un effet positif sur le rendement laitier ($P<0,05$) uniquement dans E1. Des effects significatifs ($P<0,05$) ont été trouvés également pour les facteurs ou leur interaction portant sur des modifications de poids corporel et note d'état corporel (E1 et E2) et sur le glucose dans le plasma ainsi que les acides gras non estérifiés (E2). La conclusion en est que pendant le début et la mi-lactation, des hauteurs d'herbe inférieures à 60 mm peuvent limiter l'ingestion et les performances des brebis laitières en pâturage permanent sur une prairie de ray-grass italien. La supplémentation avec du grain de maïs compense partiellement une faible ingestion d'herbage en début mais pas à la mi-lactation.*

Mots-clés : *Rendement laitier, pâturage permanent, supplémentation, brebis laitières.*

Introduction

Sward height (SH) is regarded as a reliable index of "sward state" under continuous stocking due to its relationship with both sward structure and leaf area index (Penning *et al.*, 1991). Besides this, a large body of knowledge on the effect of sward height on feeding behaviour, intake and performance of grazing sheep is now available and has been developed into practical guidelines (Hodgson, 1990). However most of such information originates from research on pastures based upon species grown under temperate conditions, grazed by sheep for the purpose of meat and wool production. Therefore a gap of knowledge still exists on the effect of sward height on feeding behaviour and performance of dairy ewes grazing annual swards in the Mediterranean region. This research project was set up in 1992 to study the dairy sheep/pasture interface in the Mediterranean environment, including the effect

of supplements. The 2nd year results on animal responses are summarized here; data on sward features are detailed elsewhere (Sitzia and Roggero, 1995).

Materials and methods

Two trials were carried out at "Bonassai" farm (NW Sardinia, 41ºN latitude, mean annual rainfall 547 mm): the first (E1) was run in winter 1992/93 (10 December - 9 January); the second (E2) in spring 1993 (28 March - 28 May). At the beginning of each trial a sward of Italian ryegrass (*Lolium multiflorum* Lam., cv. Barmultra), sown in September 1992, was divided into three paddocks, and each was kept close to the target sward heights (20, 40 and 60 mm in E1 and 30, 60 and 90 mm, in E2) by the area adjusting method. Extra-plots, adjacent to each experimental paddock, were managed to target SHs by spare ewes. Sward height was measured three times weekly by a rising-plate meter and herbage mass every three weeks cutting herbage to the ground level within quadrates (Sitzia and Roggero, 1995). Seventy-two mature Sarda ewes 53±1 (mean±SE, E1) and 98±3 days after lambing (E2), were allowed to graze experimental paddocks as one group in order to achieve the target sward heights. The ewes were then blocked according to body weight (BW), body condition score (BC, Russel *et al.*, 1969), and milk yield (MY) and randomly allotted to three 24 ewe groups (named as 20, 40 and 60 in E1 and 30, 60 and 90 in E2) that grazed continuously the corresponding paddocks. The ewes were machine-milked twice daily. Before milking, each group was split into 12 ewe subgroups either unsupplemented (subgroups -) or supplemented (subgroups +) with 500g/d of whole corn grain.

Concentrate intake was measured daily. Herbage intake (HI) was measured, on 5 animals per subgroup, on two (E1) and three occasions (E2) using the n-alkane method as described by Molle *et al.* (1995). Hand-plucked herbage samples (n=3 per paddock on each occasion) were oven-dried at 65ºC for 4 days and submitted for crude protein (CP) and neutral detergent fiber (NDF) analysis according to Martillotti *et al.* (1987). Grazing time (GT), ruminating time (RT) and idling time (IT) were automatically recorded weekly by the equipment developed by Brun *et al.* (1984). BW and BC were measured at the start and the end of each trial. MY was measured weekly; milk samples were collected for fat (MF) and protein (MP, N x 6.38) determinations (Milko-scan 133 B, N. Foss Electric, Denmark). On three occasions, during E2, blood samples were drawn from the jugular at 8:00 h a.m., before supplementation. The samples were then centrifuged and the plasma analysed for glucose (GL) and non-esterified fatty acids (NEFA) using commercial kits (Boehringer Mannheim, Germany).

The effects of SH, supplementation level (LS) and their interaction were analysed by ANOVA (HI, averaged within trial, BW and BC changes) or ANCOVA (MY, MF and MP, averaged within trial), using pre-experimental data as covariates. Feeding behaviour and plasma metabolites data were analysed by a repeated measure procedure using sheep within SH and LS as the error term. Interactions were deleted from the models if non-significant (P>0.05). Data were expressed as least square means ±SE. Differences between treatment means were tested using *t*-tests for pre-planned comparisons.

Results

E1

Sward height and herbage mass averaged 15.2±1 (20); 34.9±1 (40); 64.6±2 mm (60) and 1.11±0.03 (20); 1.73±0.06 (40); and 2.65±0.19 (60) t DM/ha, respectively.

Average CP and NDF (g/kg DM) in the herbage selected were: 247±22, 375±9 (20); 214±9, 397±8 (40); 212±5, 405±7 (60), respectively. The maize was completely consumed. HI increased along with sward height and was depressed by the supplement (Table 1). Average substitution rates, measured as reduction in HI (g DM) per unit (g DM) of concentrate consumed, were 0.56, 0.88 and 0.96 in the 20, 40 and 60 groups, respectively. GT was longer while RT and IT were shorter in the 20 group than the other treatments (Table 1).

MY was enhanced by the supplement and, was lower in 20 than in 40 and 60 groups (Table 2). Higher MF was found in 40 and 60 than in 20 group. Initial BW and BC averaged 42.37±0.48 kg and 2.60±0.01, respectively. BW and BC changes through the experiment were affected by LS; BW was also affected by SH (Table 2). Only the 20- subgroup showed a decrease in both BW and BC.

Table 1. E1 (early lactation): herbage intake (HI), grazing time (GT), ruminating time (RT) and idling time (IT) in Sarda ewes continuously grazing Italian ryegrass maintained at different sward heights (mm) either receiving 500 g/d of maize supplement (subgroups +) or nil supplement (subgroups -)

	Subgroups						Signif. of effects	
	20-	20+	40-	40+	60-	60+	SH	LS
HI (g DM)	1601±128^{ad}	1356±128^{ab}	1871±128de	1455±128^{ac}	2111±128^{e}	1727±128^{cd}	**	**
GT (min/24 h)	745±48^{a}	735±49^{a}	521±46^{bc}	615±43^{ab}	492±50^{bc}	461±42^{c}	***	NS
RT (min/24 h)	232±47^{a}	319±48^{ad}	296±45^{ac}	326±43^{ad}	378±49^{bd}	429±41^{d}	*	NS
IT (min/24 h)	463±47^{ab}	386±48^{a}	623±45^{c}	499±42^{ab}	570±49^{bc}	550±41^{bc}	**	NS

a,b,c,d,e: Means with different superscripts within rows differ significantly (P<0.05)
NS: P>0.05; *P<0.05; **P<0.01; ***P<0.001

Table 2. E1 (early lactation): milk yield (MY), milk fat (MF), milk protein (MP), body weight changes (ΔBW), body condition changes (ΔBC) in Sarda ewes continuously grazing Italian ryegrass maintained at different sward heights (mm) either receiving 500 g/d of maize supplement (subgroups +) or nil supplement (subgroups -)

	Subgroups						Signif. of effects	
	20-	20+	40-	40+	60-	60+	SH	LS
MY (ml/d)	865±62^{a}	1027±62^{ab}	1015±62^{ab}	1171±62^{b}	1074±62^{b}	1073±62^{b}	*	*
MF (%)	6.96±0.2^{a}	6.87±0.2^{a}	7.08±0.2^{ab}	6.94±0.2^{a}	7.46±0.2^{b}	7.18±0.2^{ab}	*	NS
MP (%)	6.31±0.1	6.28±0.1	6.39±0.1	6.35±0.1	6.44±0.1	6.54±0.1	NS	NS
ΔBW (g/d)	-11±16^{a}	35±16^{b}	67±16^{bc}	94±16^{cd}	84±16^{cd}	118±16^{d}	***	**
ΔBC (/period)	-0.06±0.07^{a}	0.10±0.07^{ac}	0.06±0.07^{ab}	0.19±0.07^{bc}	0.04±0.07^{ab}	0.25±0.07^{c}	NS	**

a,b,c,d: Means with different superscripts within rows differ significantly (P<0.05)
NS: P>0.05; *P<0.05; **P<0.01; ***P<0.001

E2

Sward height and herbage mass averaged 28.4±1 (30); 58.8±2 (60); 87.2±3 mm (90) and 1.40±0.17 (30); 2.85±0.43 (60); 3.19±0.42 (90) t DM/ha, respectively. Average CP and NDF (g/kg DM) in the herbage selected were 230±15, 419±10 (30); 187±15, 428±10 (60); 187±12, 422±12 (90), respectively. Average refusal of concentrate amounted to 0, 5 and 9% in 30, 60 and 90 groups, respectively. HI was higher in 60 and 90 than in 30 group (Table 3). Corn grain depressed HI (1633, for subgroups - *vs* 1220 g DM, for subgroups +, P<0.01). Average substitution rates were 0.50, (30); 1.36 (60) and 1.16 (90). GT tended to decrease (P<0.1) along with sward height 711 (30); 648 (60); 611 min/24 h (90). RT was longer in 90 than in 60 and 30 groups while no effect of treatments on IT was detected (Table 3).

MY and MP were lower in 30 compared with 60 and 90 groups (Table 4). No effect of LS was found on MY, MF and MP. Initial BW and BC averaged 44.8±0.58 kg and 2.76±0.03, respectively.

Both BW and BC changes during the trial were affected by SH and LS (Table 4). BW and BC changes were both negative in the 30 group while in the others BC tended to increase during the trial. Level of GL (Table 4) was significantly higher in supplemented as compared with unsupplemented subgroups. The interaction SHxLS affected NEFA (P<0.05): supplementation lowered NEFA with an intensity decreasing with SH.

Table 3. E2 (middle lactation): herbage intake (HI), grazing time (GT), ruminating time (RT) and idling time (IT) in Sarda ewes continuously grazing Italian ryegrass maintained at different sward heights (mm) either receiving 500 g/d of maize supplement (subgroups +) or nil supplement (subgroups -)

	Subgroups						Signif. of effects	
	30-	30+	60-	60+	90-	90+	SH	LS
HI (g DM)	1181±158^{a}	964±182^{a}	1841±141^{b}	1277±158^{a}	1878±141^{b}	1419±128^{cd}	**	**
GT (min/24 h)	692±49	731±47	670±54	627±40	648±39	578±50	NS	NS
RT (min/24 h)	282±39^{ab}	270±36^{a}	346±42^{ac}	278±31^{a}	368±30^{bc}	424±39^{bc}	**	NS
IT (min/24 h)	466±54	439±51	424±59	535±43	424±42	438±54	NS	NS

a,b,c,d: Means with different superscripts within rows differ significantly (P<0.05)
NS: P>0.05; **P<0.01

Table 4. E2 (middle lactation): milk yield (MY), milk fat (MF) and protein (MP), body weight changes (ΔBW), body condition score changes (ΔBC), plasma glucose (GL) and plasma non-esterified fatty acids (NEFA) in Sarda ewes continuously grazing Italian ryegrass maintained at different sward heights (mm) either receiving 500 g/d of maize supplement (subgroups +) or nil supplement (subgroups -)

	Subgroups						Signif. of effects†	
	30-	30+	60-	60+	90-	90+	SH	LS
MY (ml/d)	516±46^{a}	540±42^{a}	725±42^{b}	742±42^{b}	734±42^{b}	776±42^{b}	***	NS
MF (%)	7.14±0.2	7.06±0.2	6.92±0.2	6.80±0.2	7.25±0.2	7.08±0.2	NS	NS
MP (%)	6.03±0.1^{a}	6.24±0.1^{ab}	6.38±0.1^{b}	6.32±0.1^{b}	6.38±0.1^{b}	6.45±0.1^{b}	**	NS
ΔBW (g/d)	-74±10^{a}	-19±9^{b}	-17±9^{b}	15±9^{d}	-12±9^{bc}	11±9^{cd}	***	***
ΔBC (/period)	-0.05±0.05^{a}	-0.06±0.04^{a}	0.02±0.04^{ab}	0.08±0.04^{b}	0.02±0.04^{ab}	0.23±0.04^{c}	***	*
GL (mg/dl)	56±2^{a}	64±2^{c}	57±2 ^{ab}	62±2^{c}	61±2^{bc}	62±2^{c}	NS	**
NEFA (μeq/l)	360±31^{a}	130±29^{bc}	176±29 ^{bc}	134±29^{bc}	196±29^{b}	116±29^{c}	**	***

†The interaction between sward height and level of supplementation was significant only for NEFA (P<0.05)
a,b,c,d: Means with different letters within rows differ significantly (P<0.05)
NS: P>0.05; *P<0.05; **P<0.01; ***P<0.001

Discussion

Analysis of hand-plucked samples suggested that the quality of the herbage selected was not the main limiting factor in either trials. Instead, herbage intake was limited by SHs lower than 40 mm in E1 and 60 mm in E2. The ewes adapted their behaviour to these conditions increasing GT both in early (P<0.01) and middle lactation (P<0.1). The reason for the smooth response in E2 is probably due to the lower feeding drive that ewes experience in that period compared with the begin of lactation. RT tended to parallel HI: this is biologically feasible because total intake and particularly NDF intake are

known to be related to RT. The maize dramatically reduced herbage intake; this was probably due to high levels of propionate in the rumen that may cause food aversion as reported by Provenza (1995). The higher level of propionate in the supplemented ewes, compared to controls is indeed suggested by their higher plasma GL.

MY was clearly reduced by low sward conditions in both trials with a trend towards a quadratic pattern. Corn grain did compensate for limited HI only in E1 with a decreasing trend (NS) along with SH.

Milk composition showed a tendency towards a lower milk quality in the ewes grazing at lower SHs (less MF in E1 and MP in E2). SH and LS affected BW and BC changes: in E1, despite of an overall positive trend, the 20- subgroup lost both weight and condition as a consequence of a negative energy balance. In E2 a clear under-nutrition was indicated by the 30- subgroup (confirmed by NEFA results) but weight losses were found in all subgroups except for 60+ and 90+. It is probable that, in E2, irrespective of energy intake, propionate and glucose, from corn grain substantially depressed fat mobilization in the supplemented ewes compared with the other treatment. This agrees with results of Gonda and Lindberg (1993) who found a depressing effect on NEFA of propionate compared to other energy sources. The reason for the significant interaction on NEFA is probably due to the different forage/concentrate ratio (F/C), in the diets of supplemented ewes, that is known to affect propionate concentration in the rumen. F/C (on DM basis) ranked 2.2 (30+) <3.1 (60+) <3.6 (90+).

Conclusions

In the light of these preliminary results, SHs lower than 60 mm can limit intake and performance of Sarda ewes continuously grazing Italian ryegrass during early and middle lactation. Corn supplementation can offset low herbage intakes in early but not in middle lactation. This is due to the high substitution rate and, probably, to the limited efficiency for milk production of whole corn grain.

Acknowledgements

This research was funded by the EU Commission (project CAMAR, No. 8001-CT 91-0113).

References

Brun, J.P., Prache, S. and Bechet, G. (1984). A portable device for eating behaviour studies. In: *Proceedings of 5th European Grazing Workshop,* Edinburgh, UK.

Gonda, H.L. and Lindberg, J.E. (1993). Prediction of energy status in sheep from blood metabolites. In: *Proceedings of the FAO-CIHEAM Workshop on "Sheep and Goat Nutrition",* Nastis, A. (ed.). 24-29 September 1993, Thessaloniki, Greece, pp. 49-53.

Hodgson, J. (1990). *Grazing Management. Science into Practice.* Longman, Harlow, UK, p. 203.

Martillotti, F., Antongiovanni, M., Rizzi, L., Santi, E. and Bittante, G. (1987). *Metodi di analisi per la valutazione degli alimenti di impiego zootecnico* (Methods for chemical analysis of feedstuffs). IPRA, Rome, (in Italian).

Molle, G., Branca, A., Ligios, S., Sitzia, M., Casu, S., Landau, S. and Zoref, Z. (1995). Effect of grazing background and flushing supplementation on reproductive performance in Sarda ewes. *Small Ruminant Res.,* 17: 245-254.

Penning, P.D., Parsons, A.J., Orr, R.J. and Treacher, T.T. (1991). Intake and behaviour responses by sheep to changes in sward characteristics. *Grass and Forage Sci.,* 46: 15-28.

Provenza, F.D. (1995). Postingestive feedback as an elementary determinant of food preference and intake in ruminants. *J. Range Manage.,* 48: 2-17.

Russel, A.J.F., Doney, J.M. and Gunn, R.G. (1969). Subjective assessment of body fat in live sheep. *J. Agr. Sci. Camb.,* 72: 451-454.

Sitzia, M. and Roggero, P.P. (1995). Maîtrise des facteurs de production en ovins laitiers, pour réduire les coûts, offrir une alternative d'élevage pour les communautés européennes et améliorer la qualité des produits. Agronomic feautures. Programme CEE 8001-CT 91-0113. In: *Proc. of the Symposium on "Nutrition and feeding of dairy sheep: recent results and prospects",* 5-7 November 1995, St. Affrique, France, (in press).