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Effect of stocking rate on the pasture and sheep production in winter and spring lambing systems

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Abstract A two-year study investigated the effect of stocking rate on the pasture productivity and lamb performance in winter and spring lambing systems. Pastures were grazed at low (16-20 ewes + lambs ha^{-1}), medium (24-28 ewes + lambs ha^{-1}) and high (32-36 ewes + lambs ha^{-1}) stocking rates in spring 2012 and 2013. Annual pasture dry matter (DM) productions ranged from 8.9 to 10.2 t ha^{-1} but were not affected by the stocking rate. The average daily live weight gains of the winter born lambs were 73 and 10 g head^{-1}d^{-1} for low and medium stocking rates, respectively, while the lambs at the high stocking rate lost 10 g head^{-1}d^{-1} in spring 2012. The spring born lambs grew at 245, 189, 133 g head^{-1}d^{-1} for low, medium, and high stocking rates, respectively, in spring 2013. High stocking rates did not have any negative effect on the pasture production but they resulted in poor sheep performances.

Keywords. Grazing intensity – Lambing system – Live weight gain – Pasture.

Effet de la densité d'occupation animale sur le pâturage et la production ovine dans les systèmes d'agnelage d'hiver et de printemps

Résumé. *Une étude de deux ans a investigué l'effet de la densité d'occupation animale sur la productivité des pâturages et les performances des agneaux dans les systèmes d'agnelage d'hiver et de printemps. Les pâturages étaient broutés à densité d'occupation animale faible (16-20 brebis + agneaux par hectare), moyenne (24-28 brebis + agneaux par hectare) et élevée (32-36 brebis + agneaux par hectare) au printemps 2012 et 2013. La production annuelle en matière sèche (MS) pâturée variait de 8,9 à 10,2 t par hectare mais n'a pas été affectée par la densité d'occupation animale. Le gain moyen quotidien de poids vif des agneaux nés en hiver était de 73 et 10 g par tête et par jour pour la densité d'occupation animale faible et moyenne, respectivement, tandis que les agneaux exposés à une densité d'occupation animale élevée ont perdu 10 g par tête et par jour durant le printemps 2012. Les agneaux nés au printemps ont gagné 245, 189, 133 g par tête et par jour pour la densité d'occupation animale faible, moyenne et élevée, respectivement, au printemps 2013. Les taux élevés de cette densité n'ont pas eu d'effet négatif sur la production des pâturages mais ont abouti à de faibles performances des moutons.*

Mots-clés. *Intensité du pâturage – Système d'agnelage – Gain de poids vif – Pâturage.*

I – Introduction

Stocking rate is the key management variable and primary determining factor of the individual and total live weight production in pasture based feeding systems (Sollenberger, 2005). While grazing at high stocking rates may be detrimental to the plant species that are less tolerant to grazing, low stocking rates may allow the animals to be more selective in their grazing, and reduce the competitiveness of the more palatable plants. Lambing and weaning dates need to be in conformity with the grazing management, pasture growth rates and production for successfully matching the requirements of animals at varying physiological stages with forage supply and quality. Based on the management practices on mating and lambing dates coupled with the decision on the stocking rate, the efficiency of the sheep production in pasture based feeding systems may vary greatly (Penning, 1991).

The purpose of this research is to investigate the effect of stocking rate on animal and pasture productivity in winter and spring lambing systems in the Central Anatolian region of Turkey.

II – Materials and methods

This study was conducted at Bahri Dagdas International Agricultural Research Institute (37° 51' N, 32° 33' E; 1008 m asl), Konya, Turkey, from April 2011 to November 2013. A 2.3 ha paddock was cultivated and split into three blocks before sowing. The pasture mixtures comprised of *Festuca arundinacea, Dactylis glomerata, Lolium perenne, Lotus corniculatus* and *Trifolium repens* were sown in a randomized complete block design with three replications on 14 April 2011. Each block was split in three paddocks (64 x 40 m) giving a total of nine grazing plots. These plots within each replicate were randomly allocated to the treatments of low (LSR), medium (MSR) and high (HSR) stocking rates during the spring 2012 and 2013. In 2012, single lambs born during winter (mid-January) and their dams were set stocked after weaning at 20 (LSR), 28 (MSR) and 36 (HSR) ewe + lamb ha^{-1} during 24 April − 11 July. In 2013, single suckling lambs born in spring (early March) and their dams were set stocked at 16 (LSR), 24 (MSR) and 32 (HSR) ewe + lamb ha^{-1} during 19 April − 5 July. Anatolian Merino ewes (mean LW = 47.8 ± 5.3 kg in 2012 and 48.1 ± 5.9 kg in 2013) and their single lambs (mean LW = 28.0 ± 2.6 kg in 2012 and 17.1 ± 1.7 kg in 2013) were classified according to their live weights (LW) and allocated randomly to the main plots for the spring grazing experiments in both years.

Dry matter production and daily growth rates of the pasture plots at three stocking rates were measured inside 1 m^2 exclosure cages in spring, summer and autumn. All herbage from the quadrat cuts was dried in an oven (70 ºC) until constant weight. Mean daily pasture growth rates (kg DM ha^{-1} d^{-1}) were calculated at each harvest by dividing total DM production (kg DM ha^{-1}) by the duration of regrowth since the previous harvest. Live weight gain (LWG) was determined by weighing the ewes and lambs prior to and following each grazing period. Sheep were held overnight without access to feed and weighed "empty" the following morning. LWG per head was calculated from the change in weight between each LW measurement date.

Pasture dry matter production and pasture growth rates were analysed by ANOVA in randomized complete block design for each measurement period. The effect of stocking rates on LWG per head was analyzed by one−way ANOVA with repeated measures. Significant differences among treatment means were compared by Fisher's protected LSD at P= 0.05.

III – Results and discussion

Total DM production of the pastures exceeded 10 t ha^{-1} and was nearly equal for all the three pasture stocking rates in 2012 (Fig.1 a). DM production of pastures in 2013 ranged from 8.9 to 10.1 t ha^{-1} but the stocking rates had no effect ($P > 0.05$) on the seasonal or annual DM production. Similarly stocking rates had no significant effect ($P > 0.05$) on the mean daily pasture growth rates (Fig.1 b). The absence of a stocking rate effect on the DM production of the pastures that consisted of perennial species was probably due to the relatively short duration of the different stocking rates imposed only in the spring seasons. Similarly, Thompson *et al.* (1994) for annual pastures grazed at stocking rates ranging from 8 to 40 sheep ha^{-1} in Australia, and Ates *et al.* (2013) for pastures grazed at 8.3 and 13.9 sheep and their twin lambs ha^{-1} in New Zealand, reported that spring stocking rates did not affect total annual pasture production.

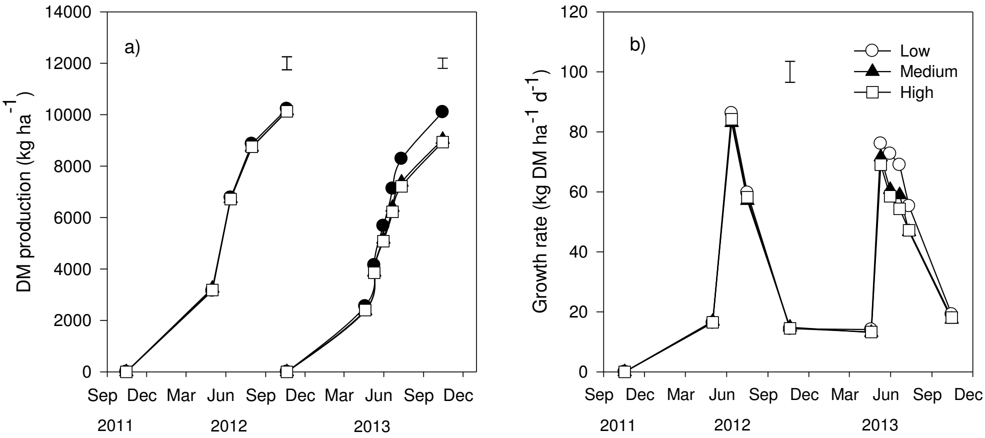

Fig. 1. Pasture DM production (kg ha^{-1}) (a) and growth rates (kg DM ha^{-1} d^{-1}) (b) at spring stocking rates of 16-20 (low), 24-28 (medium) and 32-36 (high) ewes with single lambs ha^{-1} from 2011 to 2013. Bars represent the SE for (a) and maximum SE for (b).

In 2012, an interaction was detected between LWG and measurement period for LWG of lambs (Table 1). Lambs had increases in their LWs at various levels ranging from 89 to 144 head^{-1} d^{-1} during the first period, whereas during the second period the lambs at MSR and HSR had significant LW losses the and lambs at LSR showed negligible LW gains. The mean lamb LWGs per head in 2013 were 245, 189, and 133 head^{-1} d^{-1} at LSR, MSR and HSR, respectively. An interaction occurred that year between stocking rate and the measurement period for LWG of the lambs because only the lambs at LSR had increases in their LWs at the final period, whereas lambs at MSR and HSR lost weight during the same period. The final LWs of lambs (at mean 177 d old age) in winter lambing system was 33.7, 28.8 and 27.2 kg for LSR, MSR and HSR, respectively, whereas the final LWs of lambs (at mean 120 d old age) in spring lambing system was 36.0, 31.7 and 27.3 kg for LSR, MSR and HSR, respectively. These findings indicate that the LWGs of lambs need to be maximized during spring and lambs weaned and drafted before the end of June when the pastures have a major decline in their daily growth rates due to increasing temperatures and summer dormancy. Furthermore, applying lower grazing rates and/or supplemental feeding may be necessary particularly in winter lambing system to maintain the high lamb growth rates before the onset of high summer temperatures.

Significant decreases in ewe LWG per head occurred over the grazing periods but the magnitude of decline in ewe LWG losses was greater ($P<0.05$) at MSR and HSR than LSR. This caused a significant interaction between stocking rate and period both in 2012 and 2013. Ewes have the ability to adapt to nutritional constraints through mobilization or accumulation of body reserves in forage based feeding systems that often consist of underfeeding and re-feeding periods depending on the seasonal pasture growth and stocking rate. Despite the higher stocking rates imposed in the spring grazing in 2012 compared to 2013, the weight losses that were observed on ewes were not as dramatic as in 2013. As lambs on these ewes achieved high growth rates compared to winter-born lambs, the results suggest that the suckling lambs may have benefitted from the buffering effect of the mobilization of adipose reserves to maintain milk production which commonly occurs early stages of lactation (Blanc *et al.*, 2006). The implication of weight loss during lactation is that ewes grazing at HSR need to gain more body weight during summer and early autumn to meet pre-mating live weight targets for the improvement of conception rates.

Table 1 Mean live weight gain per lamb and ewe (g head^{-1} d^{-1}) in 2012 at 20 (low), 28 (medium) and 36 (high) ewes with single lambs ha^{-1} and in 2013 at stocking rates (SR) of 16 (low), 24 (medium) and 32 (high) ewes with single lambs ha^{-1}

Year	Period	Lamb			Ewe		
		Low	Medium	High	Low	Medium	High
2012	24 Apr–30 May	144	104	89	187	132	123
	30 May–11 July	2	−84	−108	−38	−125	−168
	Mean	73	10	−10	75	3	−23
	SE*		7.2			9.3	
	$P_{\text{Stocking rate (SR)}}$		0.01			0.01	
	$P_{\text{Period (P)}}$		0.01			0.01	
	$P_{\text{SR x P}}$		0.01			0.05	
2013	19 Apr–10 May	319	294	292	157	98	69
	10 May–31 May	272	239	180	6	−52	−220
	31 May–21 June	251	170	58	29	−104	−124
	21 June–5 July	95	−2	−51	−69	−121	−128
	Mean	245	189	133	31	−44	−101
	SE*		16.3			25.5	
	$P_{\text{Stocking rate (SR)}}$		0.01			0.01	
	$P_{\text{Period (P)}}$		0.01			0.01	
	$P_{\text{SR x P}}$		0.01			0.01	

*Maximum S.E (standard error) for the interaction (SR × P).

IV – Conclusions

Medium stocking rates in early spring with reduced stocking rate towards summer would be a good strategy for optimum pasture management in both lambing and grazing systems.

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