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The effects of body condition score and flushing on the reproductive performances of Ripollesa breed ewes mated in spring

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SUMMARY - The relations between body condition score (BCS) at mating and the reproductive performances of a flock of Ripollesa breed ewes were studied. The ewes were mated naturally in the spring of four consecutive years (n= 355). The flock was managed under a semi-intensive system, with feeding based on natural pasture grazing over the mating period. Grain flushing (0.85 Mcal NE/ewe/day) was given to half the ewes in the last two years. Average values for BCS at mating, 3.32; fertility, 85.1 % and prolificacy, 1.38 lambs/ewe, were recorded. Year effects were significant (P<0.07 to P<0.001) but not those due to flushing. According to BCS categories at 0.5 unit intervals, significant differences were observed only for fertility (P<0.05 to P<0.1), which gave highest values of between 3 and 3.5 for BCS. In conclusion, the BCS at mating seemed to affect fertility more than prolificacy. The effects of flushing were not significant under our working conditions.

RESUME - Les relations entre état corporel (EC) au moment de la mise à la lutte et les performances reproductives, ont été étudiées pendant quatre années successives (n= 355), dans un troupeau de brebis de race Ripollesa mises à la lutte naturelle au printemps. Le troupeau a été maintenu en conditions semi-intensives, avec pâturage en prairies non irriguées pendant la lutte, et pour les deux dernières années, un traitement de "flushing" (0,85 Mcal EN/brebis et jour) a été réalisé avec la moitié du troupeau. Les résultats obtenus ont indiqué ces valeurs moyennes: EC à la lutte= 3,32; fertilité= 85,1 % et prolificité= 1,38 agneaux/brebis, en vérifiant des effets significatifs (P<0,07 à P<0,001) à cause de l'année et non du «flushing». L'analyse par classes d'EC, par intervalles de 0,5 unités, a fait apparaître des différences significatives de fertilité (P<0,05 à P<0,10) entre les classes. Les valeurs les plus élevées correspondaient à un EC se trouvant entre 3,0 et 3,5 unités. En conclusion, la fertilité a été plus influencée par l'EC à la lutte que la prolificité, et le «flushing» n'a pas eu d'effet significatif dans les conditions de ce travail.

Introduction

The importance of body fat reserves in the ewe at mating and its relation to short and medium term reproductive performance has been widely discussed by various authors in recent years. In practice, the estimation of body fat reserves at mating, by means of live weight or body condition score (BCS), as defined by Russel *et al.* (1969), has demonstrated the existence of a positive relation to ovulation rate, fertility, or, to a lesser extent, the prolificacy of several sheep breeds (Guerra *et al.*, 1972; Gunn *et al.*, 1969; 1972 y 1979; Gunn and Doney, 1973; Newton *et al.*, 1980; Knight and Hockey, 1982; Folch *et al.*, 1983; Rhind *et al.*, 1984; Paramio and Folch, 1985; Gibon *et al.*, 1985; Folch *et al.*, 1987; Thomson and Badhady, 1988).

Because of its simplicity and ease of management, the use of BCS has been widely accepted and recommended as an indicator of the nutritional status of sheep (MLC, 1983; INRA, 1988). A practical

recommendation was to achieve a score of 3-3.5 at mating. The use of BCS is also of great help in the interpretation of the reproductive performance of a flock in relation to management and feeding under difficult grazing conditions, as Gibon *et al.* (1985) observe.

However, the relations between live weight, feeding and body fat reserves in sheep are complex, and in many cases difficult to clarify. As a result, the short and medium term reproductive results may be contradictory, or specific to a particular breed or farming conditions. This problem applies especially to Spanish breeds and to spring matings, when feeding seems to have less effect on ovulation rate (Paramio and Folch, 1985) and when the lower than expected prolificacy would make flushing less useful, as noted by Thomson and Badhady (1988).

For these reasons, in this work, BCS at mating has been evaluated for a «Ripollesa» breed flock under traditional feeding for the area in the spring of four consecutive years. The effects of the BCS on reproductive parameters were analysed. The effects of a grain flushing on the reproductive parameters were also analysed.

Material and methods

The reproductive results and body condition scores of a flock of «Ripollesa» breed ewes (n= 355), under semi-intensive management and night housing, were used. The reproductive frequency was one lambing per year, using natural mating in the spring (1 April-15 June) of four consecutive years. The flock belongs to the experimental farm of the Veterinary Faculty of the «Universidad Autónoma de Barcelona», Bellaterra (Vallès Occidental, Barcelona, North-East Spain).

Body condition score was controlled every two weeks throughout the mating period, using the method described by Russel *et al.* (1969), with an approximation of 0.5 units. The apparent fertility (number of ewes lambing/total number of ewes) and prolificacy (number of lambs/number of ewes lambed) was evaluated in the corresponding lambing period (autumn).

The flock was kept under similar management conditions for the mating season of each year. This was: semi-intensive farming, traditional to the area, with shepherded grazing (7 hours/day) on natural pastures (rainfall: 500-600 mm/year) with a complement of medium quality hay of vetch-cereal (0.5 kg/ewe per day) under housing. Mating took place only at night under housing (5pm-10am), the ewes being homogeneously grouped after grazing. One ram was assigned to each group of 15-20 ewes. The groups were formed according to age, weight and BCS with the aim of homogeneity. The rams were painted in the sternal zone with coloured wax to mark the mated ewes; the results were recorded daily.

In the last two years (1988 and 1989), half the ewes in the flock were flushed with whole barley grain (0.85 Mcal NE/ewe/day; 0.5 UFL). In order to evaluate its reproductive effects, flushing was given under housing once a day for 51 days (17 days before and 34 days after the ewes were first exposed to rams), before the ewes went for grazing. The period of adaptation and to withdrawal of the treatment was of one week in each case.

Statistical variance analysis was applied to the results obtained, using the BMDP package (Dixon *et al.* 1988). For the comparison of mean fertility and prolificacy the X^2 test after Pearson (Snedecor and Cochran, 1984) was used.

Results and discussion

The results obtained from the analysis of variance gave mean values for BCS at mating, fertility and prolificacy of 3.32, 85.10 % and 1.38 lambs/ewe, respectively, for the 355 ewes used throughout the experimental period. The year effects were highly significant ($P<0.001$) for BCS at mating, and also for fertility, but only at the level of $P<0.07$ for prolificacy (Table 1).

For the last two years (1988 and 1989) in which 145 ewes were given flushing, the respective values were: 2.89, 81.38 % and 1.39 lambs/ewe. The year effect on fertility ($P<0.001$) and prolificacy ($P<0.01$) was significant, but not on BCS at mating. The effects of flushing and its interaction with the year were not significant for any of the variables analysed.

The annual variations of the variables studied, when they were significant, are summarised in Table 2. As can be seen from this table, BCS at mating varied between 2.82-3.71, due to the effect of yearly climatic differences which affected the nutritive value of the natural pastures used. The maximum variation observed was 0.89 units and its difference was significant ($P<0.05$) between two consecutive years (1988 and 1989). Similar effects of the year on BCS at mating in spring have been observed by Gibon *et al.* (1985) in mountain grazing ewes.

In spite of these variations in BCS, the production system used in this work seemed to permit the mating of «Ripollesa» ewes in spring with satisfactory BCSs, in accordance with the recommendations made by MLC (1983) and INRA (1988). It was not necessary to use

large quantities of hay, grain or concentrates to achieve this.

Flock fertility varied from 65.6-92.9% for the years studied. This was the variable with the highest variation (27.3 points) due to year effect of all those studied, following a similar pattern to that observed by Gibon *et al.* (1985). However, this high variation is due to the fertility observed in the last year (1989), which was significantly different ($P<0.05$) from the other years studied. The decrease in fertility was probably not due to feeding, since the mean BCS of the flock at mating in this year (2.99) was satisfactory. The mean value and interval of variation of fertility, excluding this particular year, was 89.1% (84.0-92.9%), which greatly improves the values cited above.

Prolificacy varied annually between 1.23-1.47 lambs/ewe, giving a difference of 0.24 lambs/ewe. Variation of prolificacy was significant ($P<0.07$) between years. Its lowest value coincided with the year of least fertility (1989).

In spite of the variations observed annually, the reproductive results obtained in natural spring matings gave high values for fertility and prolificacy, when compared to the mean of Spanish sheep breeds. These values agreed with those described previously by Ferret *et al.* (1987) and Torre *et al.* (1989), under different conditions, for the «Ripollesa» breed.

The results of flushing are shown in Table 3, in which, together with the productive parameters studied, the evolution of BCS during treatment is shown. Under our working conditions, no significant differences were observed in any of the variables studied, although there was a tendency to an improvement in fertility (+8.6 points) and prolificacy (+0.02 lambs) in the flushed groups.

Flushing does not significantly affect BCS either, in spite of the daily contribution of 0.85 Mcal NE per ewe, for the 51 days of treatment. So not only the initial BCS (2.63) and the final BCS (3.10) of the treatment but also the BCS at mating (2.89) were similar for both groups. The increase in the BCS at mating observed in the ewes of the control group (+0.49) was comparable to that of the flushed group (+0.46).

This seems to indicate that the pastures used gave sufficient nutrition, both in quantity and quality, to insure an important recovery of weight at the end of winter and an adequate BCS at mating. The use of supplementary feeding not only did not improve the BCS at mating, but must also have produced a reduction in the amount of grass consumed at pasture.

As a result, although the BCS at the beginning of mating made flushing recommendable, in accordance with MLC (1983) and INRA (1988), the abundance of grass in pasture must have produced a flushing effect of its own, thus raising the BCS at mating to satisfactory values.

Given the previous results, an overall study of these results was undertaken for categories of BCSs between 2.0-4.5 at intervals of 0.5 units, with the aim of evaluating the static effects of body fat reserves on the reproductive parameters of ewes mated in the spring. The results obtained are shown in Table 4, together with the analysis of their differences using the X^2 test, and in Figure 1.

As can be seen from Table 4 the X^2 test showed the existence of low significant differences for fertility ($P<0.10$), with values between 75.0-90.9%, but not for prolificacy which varied from 1.33-1.44 lambs/ewe. Although a comparison with the results of other authors is difficult, the values obtained for fertility, for each BCS category, were higher than those observed by Paramio and Folch (1985) for «Rasa Aragonesa» breed ewes in spring (fertility 52-75%), except for ewes observed to have a BCS of 5 by these authors. The values for prolificacy at each BCS category were also higher than those obtained by Paramio and Folch (1985) in natural spring mating (1.0-1.2 lambs/ewe).

It can be said then, that the fertility of the flock used in spring matings was related to the BCS and gave a maximum for a value of 3 (90.9%). This was signigicantly different for values lower than 2.5 ($P<0.05$) or higher than 4 ($P<0.07$). In contrast to the results obtained by Paramio and Folch (1985), a significant decrease in the fertility of ewes with the highest body fat (BCS > 4) was observed. As shown in Figure 1, the values for the BCSs at mating and fertility have a tendency to normal curve distribution. This seems to indicate that in practice, values lower than 2.5 or higher than 4 are undesirable, so that the 3.0-3.5 BCS recommendations of MLC (1983) and INRA (1988) should be valid for «Ripollesa» breed ewes mated in spring.

As the number of ewes in each group and the differences in their reproductive performances were small, the analysis of flushing effects according to BCS grouping was omitted. However, flushing would be expected to produce a positive effect on the fertility of very low BCS ewes in spring mating (Folch *et al.* 1987).

Conclusions

Under our working conditions, using «Ripollesa» breed ewes and especially for spring mating, the BCS seems to affect fertility more markedly than prolificacy, as Gibon *et al.* (1985), Paramio and Folch (1985) and Folch *et al.* (1987) observed. Mean BCS should be

between 3.0-3.5 to achieve the best reproductive results in «Ripollesa» breed ewes, but performances did not show significant differences between 2.5-4.0 scores.

When young spring grass is abundant and the BCS is moderately less than the optimum recommended (2.5-3.0), energetic flushing cannot be expected to produce significant effects on fertility or prolificacy. Its practical use in these cases is therefore questionable, as Thomson and Badhady (1988) observed in "Awassi" ewes.

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Table 1: Analysis of variance results of the effects in body condition score (BCS) at mating and reproductive performances of Ripollesa breed ewes.

Studied variable	Mean ± Standard Error	Source of variation			
		Year[1]	Year[2]	Flushing[2]	YxF[2]
N.° of ewes	355	–	–	–	–
BCS at mating	3.32 ± 1.91	***	NS	NS	NS
Fertility	85.10 ± 1.91	***	***	NS	NS
Prolificacy	1.38 ± 0.04	*	**	NS	NS

(1= years 1986 to 1989, 2= years 1988 to 1989 with flushing; ***= p<0.001, **= p<0.01, *= p<0.07, NS= Non significant).

Table 2: Annual variation of the body condition score (BCS) at mating and the reproductive performance of Ripollesa breed ewes mated in spring.

Year	No of ewes ewes	Fertility[1] (%)	Prolificacy[2] (lambs/ewe)	BCS
1986	116	90.50[a]	1.36[ab]	3.55[a]
1987	94	84.03[a]	1.40[a]	3.71[a]
1988	84	92.86[a]	1.47[a]	2.82[b]
1989	61	65.57[b]	1.23[b]	2.99[b]
M ± SE	355	85.10 ± 1.91	1.38 ± 0.03	3.32 ± 0.04
Sig. Level	–	***	*	***

(M ± SE= Mean ± Standard error; ***= p<0.001, *= p<0.07, NS= Non significant; a, b= Different letters indicate X^2 significant differences within columns at levels [1]= p<0.05 and [2]= p<0.07).

Table 3: Comparison of body condition score (BCS) at mating and reproductive performance of Ripollesa breed ewes mated using flushing in spring.

Studied variable	Experimental group		Mean ± SE	Level of Sign.
	Control	Flushing		
No. of ewes	59	86	145	
BCS at:				
— start of flushing	2.60	2.65	2.63 ± 0.07	NS
— succesful mating	2.89	2.89	2.89 ± 0.05	NS
— end of flushing	3.09	3.11	3.10 ± 0.06	NS
BCS variation	+0.49	+0.46	+0.48 ± 0.03	NS
Fertility	76.27	84.88	81.38 ± 0.03	NS
Prolificacy	1.38	1.40	1.39 ± 0.05	NS

(1 = years 1988 and 1989; SE = Standard error; NS = Non significant differences within columns).

Table 4: Effect of body condition score (BCS) at mating on the reproductive performance of Ripollesa breed ewes mated in spring.

BCS	N.° of ewes	Fertility (%)	Prolificacy (lambs/ewe)
≤ 2	29 (8.2)	75.0[a]	1.33
2.5	40 (11.3)	85.0[ab]	1.41
≤ 3	89 (25.1)	90.9[b]	1.33
3.5	96 (27.0)	86.3[b]	1.44
4	73 (20.6)	84.9[ab]	1.37
≥ 4.5	28 (7.9)	75.1[a]	1.40
Mean ± SE	355 (100 %)	85.1 ± 2.0	1.38 ± 0.03
Sign. Level	–	*	NS

(SE = Standard error; NS = Non significant; * = P < 0.10; a, b = Different letters indicate significant differences at P < 0.10 using x^2).

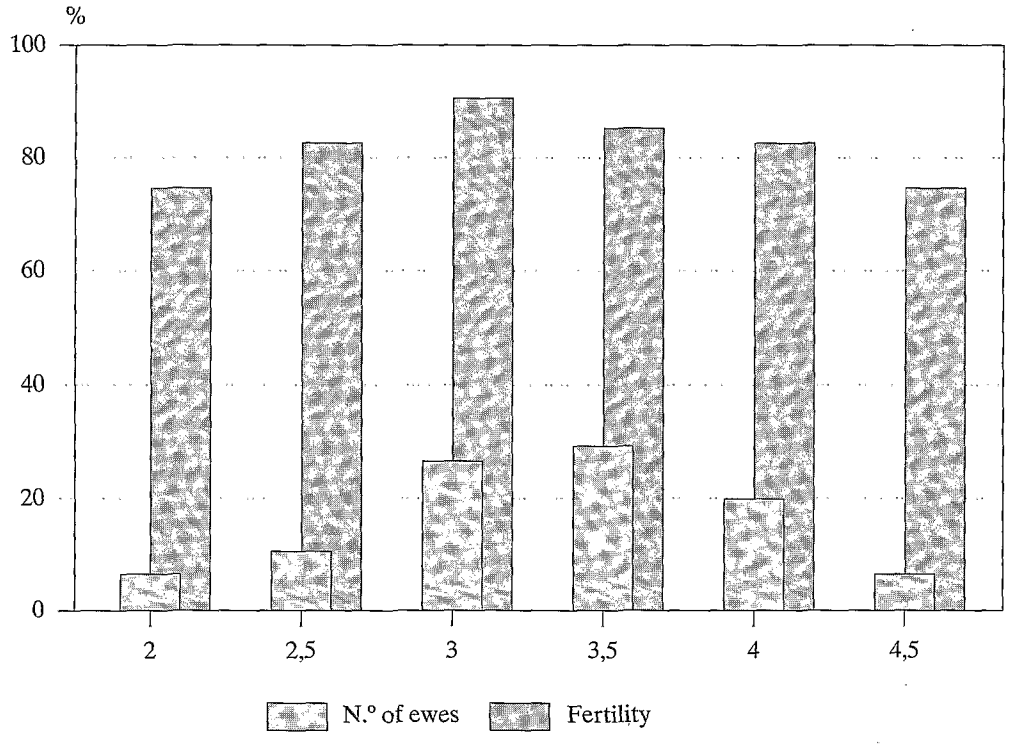

Fig. 1. Body condition score at mating and its effect on the fertility of Ripollesa breed ewes mated in spring.