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Small Ruminant Research 48 (2003) 233–237

Small Ruminant Research

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Technical note

The effect of paddock size on the response of seasonal anoestrous ewes to the ram effect

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Accepted 17 December 2002

Abstract

Many aspects of the conditions required to maximize the ewe's response to ram introduction in the late anoestrous season remain unclear. The aim of this research was to determine whether grazing space allowances could influence the efficacy of the ram effect. In August 1995, at Reading (latitude 51°27′N), following a 3-month isolation period from rams, two groups of nulliparous Mule ewes, aged 15 months, were introduced to four rams in a low (12 ewes/ha; treatment L, $n = 124$) or in a high stocking rate (84 ewes/ha; treatment H, $n = 126$). From the beginning of August until the end of August oestrous behaviour was recorded by daily checks of mating marks on ewes. Rams were removed and in October all ewes were scanned (day 50) for pregnancy. No significant differences were found in the parameters investigated. Eighty-two percent of the L and 75.4% of the H ewes exhibited oestrus, with a pronounced peak on day 23 following ram introduction and a compact concentration in the 21–25-day period. The oestrous synchronisation rate in this 5-day period was 69.4 and 68.3%, respectively for L and H. The mean interval from ram introduction to oestrus was 23.17 ± 2.4 days in L and 23.0 ± 2.2 days in the H group. Conception rates were 84.3 and 87.4% for L and H groups, respectively. These results suggest that the response of anoestrous ewes to the introduction of rams was not affected by grazing space allowances and that yearling Mule ewes respond well to the ram effect in the late anoestrus season.

Keywords: Sheep; Reproduction; Seasonality; Ram effect; Anoestrus

1. Introduction

Various studies have shown paddock size to have an effect on the reproductive performance of ewe flocks, with small paddocks improving the number of ewes detected in oestrus (Lindsay and Robinson, 1961), the number of rams mating each ewe (Lindsay and Robinson, 1961; Davis and Allison, 1976a), the number of ewes mated and lambed (Marincowitz et al., 1966) and also the activity of ewes seeking out rams (Davis and Allison, 1976b). According to this, it can be reasonably assumed that small paddocks will promote proximity between ewes and rams which in turn will facilitate the frequency of contact and interaction with consequent improvement in the visual, auditory, tactile and olfactory stimulation received by the ewes. The aim of the present study was therefore to compare the effect of two different paddock sizes on various parameters of sexual response in seasonal anoestrous ewes to the introduction of rams.

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doi:10.1016/S0921-4488(03)00049-X

2. Material and methods

2.1. Animals and treatments

Two hundred and fifty nulliparous Northcountry Mule (Bluefaced Leicester ♂ × Swaledale ♀) ewes aged 15 months, weighing 61.6 ± 5.02 kg and with a mean body condition score of 3.4 ± 0.54 (0, extremely emaciated; 5, excess fatness; Russel et al., 1969) were randomly allocated to two treatment groups and stocked at 12 ewes/ha (L: $n = 124$) or 84 ewes/ha (H: $n = 126$). The ewes were kept on predominantly rye-grass swards in two paddocks (group L: 10.5 ha; group H: 1.5 ha). The ewes had been maintained in a pasture for the previous 3 weeks and had no contact with any ram for at least 3 months. Four Texel rams fitted with crayon markers were introduced to each group in the onset of August. The rams, (aged 4 years) were sexually active and fertile. Oestrous behaviour was recorded once daily by checks made of raddle marks on ewes until the end of August, when the rams were removed. All ewes were ultrasonically scanned for pregnancy approximately 50 days after mating. The color of the crayons was changed at 10-day intervals. The parameters investigated were firstly the proportion of ewes displaying oestrus until day 29 following ram introduction, oestrous synchronisation efficiency, interval from ram introduction to oestrus, pregnancy rate and litter size.

2.2. Statistical analysis

Treatment differences in the proportion of ewes showing oestrus in the 29-day experimental period, oestrus synchronisation rate, pregnancy rate and litter size, were tested by χ^2 analysis after data have been arranged in contingency tables. The χ^2 was corrected for continuity. Differences in mean interval to oestrus were compared by Student's *t*-test (Zar, 1996).

3. Results

Tables 1 and 2 summarize the results of this study. There were no significant differences between groups in the parameters investigated. Overall, 79% of the ewes were marked by the rams during the first 29 days of ram presence, with 7% more ewes in treatment L being marked during this period. As far as the distribution of oestrus is concerned, a pronounced peak on day 23 and a compact occurrence during the 21–25-day period was observed in both treatments with 69 and 68% of ewes, in groups L and H, respectively, demonstrating overt oestrus during this period (Fig. 1). As a consequence, mean interval from rams introduction to oestrus averaged 23 days in both groups (S.E.M. = 0.24 in group L and S.E.M. = 0.23 in group H). The efficiency of oestrous synchronisation, when considered as the proportion of ewes showing oestrus during the 21–25-day period in relation to the total of the ewes showing oestrus during the experimental period, was high and similar in both treatments (84.3 and 90.5%, for L and H, respectively; Table 1). The pregnancy rate recorded at scanning of marked ewes was 84.3% for the L ewes and 87.4% for the H ewes or 69.4 and 65.9% ewes exposed to the rams in the L and H treatments, respectively (Table 2). The percentages of pregnant ewes carrying singles, twins or

Table 1
Effect of space allowances upon the oestrous response of Mule ewes to the introduction of rams

Group (no. of ewes)	Ewes showing oestrus in 29 days[a]	Oestrus synchronisation rate in the 21–25-day period (%)[b]	Mean interval to oestrus (days)[c]
L (124)	102 (82.3)	84.3 ($n = 86$)	23.17 ± 0.24
H (126)	95 (75.4)	90.5 ($n = 86$)	23.04 ± 0.23
Total (250)	197 (78.8)	87.3 ($n = 172$)	23.1 ± 0.16

Differences are not statistically significant.

[a] Values in parentheses are percentage.

[b] Oestrus synchronisation rate is defined as the proportion of ewes showing oestrus in a limited period in relation to the total of ewes showing oestrus in the experimental period.

[c] The values are expressed in mean ± S.E.M.

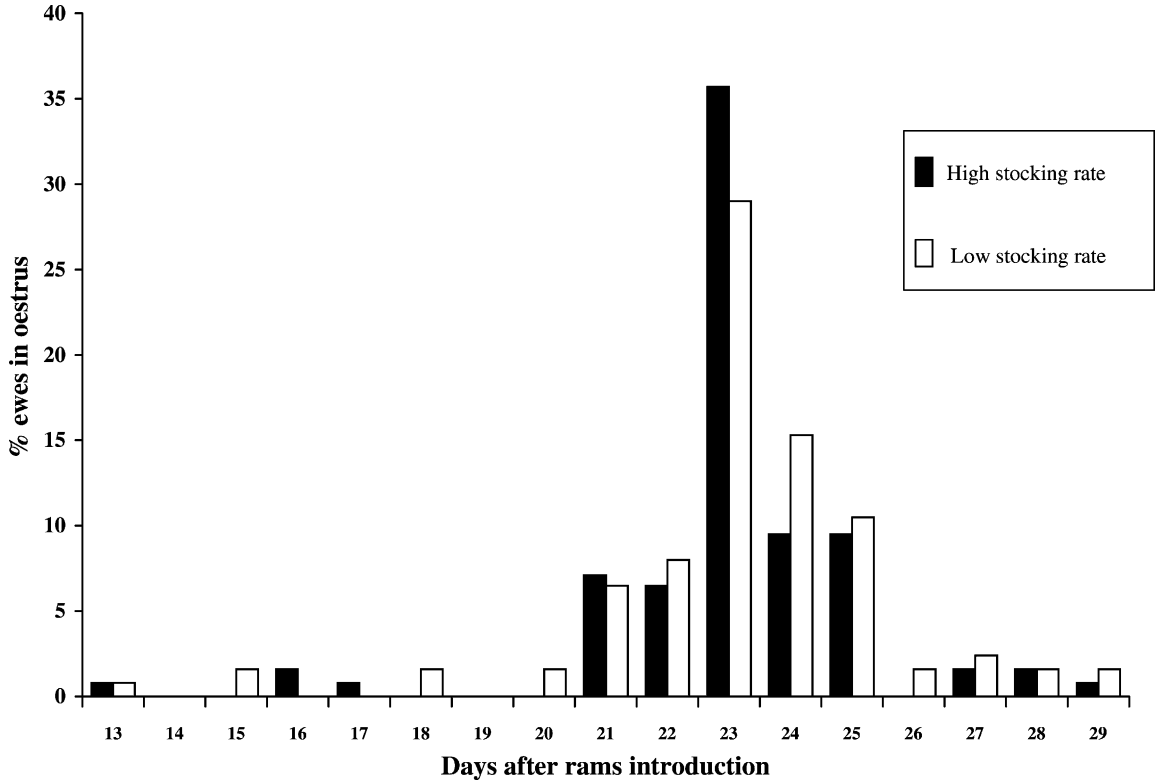

Fig. 1. Percentage distribution of yearling Mule ewes showing oestrus after ram introduction according to density of stocking.

Table 2
Pregnancy rate and litter size in Mule ewes stimulated to ovulate by the introduction of rams in different space allowances

Group	Pregnancy rate[a] (%)	Pregnancy rate[b] (%)	Litter size at scanning
L	84.3	69.4	1.72
H	87.4	65.9	1.65
Overall	85.4	67.7	1.69

Differences are not statistically significant.
[a] Ewes pregnant/ewes served.
[b] Ewes pregnant/ewes present to rams.

triplets were 31.4, 66.3 and 1.2% for treatment L and 37.3, 60.2 and 2.4% for treatment H respectively.

4. Discussion

In this experiment, there was a clear response of the ewes to the introduction of rams, with almost 80% displaying oestrus during the first 29 days of contact. There is no guarantee that oestrus was induced by the rams in all instances, since it is possible that some ewes were ovulating spontaneously independently of the contact with rams. An accurate response could only be established if a control group of ewes kept isolated from rams during the experimental period were included, or if the ewes were subjected to laparoscopy, or the levels of serum progesterone were determined before ram introduction. However, the analysis of the pattern of oestrus distribution seems to be elucidative in this case. The pattern of response of anoestrous ewes to ram introduction has been well established (Knight, 1983). If ewes are not pre-treated with progesterone, silent ovulations will occur within 2–3 days and in some ewes this ovulation will be followed by a new silent ovulation 4–6 days later. The occurrence of oestrus usually spreads over 10 days, with peaks around days 18 and 24. In the present experiment, from the ewes which showed oestrus, 41% showed oestrus

on day 23 and 87% during the period between days 21 and 25. On the other hand, no oestrous ewes were detected before day 13 (Fig. 1) and only 11 (4%) were detected before day 21. These results together, therefore, strongly suggest that virtually all of the oestrous behaviour was induced by the rams.

The overall proportion of ewes showing oestrus and the oestrous synchronisation rate observed can be considered high, regarding the strong seasonality of the breed used, the season when the experiment was carried out (well before the beginning of the natural reproductive season) and especially the age of the ewes. In fact, it is known that young ewes tend to respond to the ram effect to a lesser extent than adult ewes. In the two studies described by Murtagh et al. (1984), only 25–27% of 14–15-month-old Merino ewes displayed ram-induced oestrus, compared to 75% of adult flockmates. Rodríguez Iglesias et al. (1991) also found that 15-month-old Corriedale ewes had less ability to respond to ram introduction than adult ewes. In the four treatments designed to explore the effect of various degrees of association between rams and ewes, these authors detected a systematic and always significant increased proportion of adult ewes ovulating (96% versus 53%, 68% versus 59%, 57% versus 50%, and 32% versus 24%).

The lack of a biphasic spread of first oestrus, with only one peak observed on day 23, suggests that almost all ovulated ewes experienced a short oestrous cycle following the first ovulation. Short oestrous cycles tend to occur in about 50% of adult ewes (Cognie et al., 1982), but data for young ewes has not been recorded. These results suggest that yearling ewes may be more susceptible to premature regression of ram-induced *corpus luteum* than adult ewes.

Approximately 7% more ewes in the larger paddock were marked by the rams, but it was most probably due to chance. Due to the lack of statistical significance of the differences, the seven ewes responsible for the difference were served out in the 21–25-day period, when 87.3% of the total marked ewes were marked and where the difference between treatments was negligible (1%). It can be argued, on the basis of what has been mentioned above, that if some oestrous behaviour had occurred independently of the rams presence, it might have been displayed before day 21 and after day 25. The differences observed in this trial were not due to the treatments imposed.

It was postulated that a small paddock should promote proximity and physical contact between rams and ewes and consequently increase the intensity of visual, auditory and tactile stimuli as well as facilitate the reception of pheromones which would enable the ewes to respond more effectively to the ram effect. The absence of significant differences between the two groups (stressed by the better performance of the L ewes), clearly showed that the hypothesis was not confirmed. Either the intensity of contact in the two groups were of approximately the same level, due to the ability of the rams in the large field to seek out and keep close to the ewes, or the differences in the stimulation achieved by restrictions in space was not big enough to promote differences at a physiological level. If one considers the tendency of the ewes in the small paddock to spend more time close to the rams (a fact observed but not quantified), then this study supports the results of Perkins and Fitzgerald (1994) who suggest the close proximity between ewes and rams in a non-sexual context does not increase the reproductive response of the ewes.

Parameters of sexual behaviour of rams were not recorded in this study. Although it can be assumed that the two groups of rams were potentially homogeneous in their sexual activity, doubts remain of what the effect of treatment was on sexual behaviour of rams and the consequent effect on the reproductive response of the ewes. However, observations made in a series of other studies carried out (Rosa et al., 2000a,b) which allowed for a better understanding of the behavioural relationship between rams and ewes in the field, contributed to a better explanation of the present results. In these studies, it was observed that, following the sudden introduction to the ewes, the rams actively start seeking the ewes, trying to identify those in oestrus, while displaying courtship behaviour. During this initial period, the rams tend not to graze or rest and are completely involved in sexual activities. During this phase, which may be the most important in terms of the recruitment of those ewes that are going to respond to rams, space in excess do not seem to restrict the contact between sexes. Firstly, because of the natural gregarious instinct of the species and secondly because, even if the ewes start spreading out, the rams continue seeking them out probably more than if they are confined, a situation in which the rams tend to start grazing, after quickly identifying the anoestrous

condition of the ewes. It therefore seems reasonable to assume that any increase in ram stimuli enabled by the close proximity between sexes in the small paddock, was compensated by an increase in behavioural stimuli provided by the rams in the large paddock.

In conclusion, the results of the present study suggest that: (1) differences in paddock sizes ranging from 1.5 to 10 ha, containing stocking densities of 12–84 ewes/ha, have no effect on the response of anoestrous ewes to the introduction of rams; and (2) if preconditioned by a long period of isolation from rams, yearling Mule ewes can respond to teasing in the late anoestrous season with a good rate of oestrous synchronisation.

Acknowledgements

The authors would like to thank PRAXIS XXI programme, Lisbon, for financial support.

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