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Oestrus Synchronization in Merino Sheep Using Intravaginal Sponges, Estrumate and PMSG on Oestrus Activity During Non-breeding Season

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ABSTRACT

The aim of this study was to compare the effectiveness of different synchronization protocols on estrus activity in Merino ewes during the non-breeding season. The objectives of this study were (i) to determine the effectiveness of using intravaginal sponges alone to synchronize estrus during non-breeding season, (ii) to determine the effectiveness of using Estrumate alone to synchronize oestrus during non-breeding season, (iii) to determine the effectiveness of using the combination of intravaginal sponges, Estrumate and GnRH to synchronize estrus during non-breeding season. Four different protocols were used as follows: TRT A (control), TRT B (were inserted intravaginal sponge for 12 days), TRT C (double injection of prostaglandin at day 0 and 11), TRT D (intravaginal sponges 12 days, single injection of prostaglandin at day 12 and single injection of gonadotropin-releasing hormone). The results were statistically significant ($p < 0.05$) based on an interval from withdrawal of treatments to onset of estrus, estrus response, duration of estrus as well as interval from withdrawal of treatment to end of estrus during the non-breeding season hence ewes treated with double injection of prostaglandin was the most effective.

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INTRODUCTION

Sheep are seasonal breeders, typically mating when day length decreases and nights are longer (Rosa and Bryant, 2003). Estrus synchronization in sheep offers several benefits, including reducing pressure on rams, shortening the lambing period, improving efficiency, and lowering labor requirements (Yu et al., 2022). Synchronization also produces a more uniform lamb crop, which enhances flock replacement strategies and improves overall economic returns (Ravikumar, 2008). Various synchronization protocols have been developed, often involving single or combined hormonal treatments (Pursley et al., 1995). Among these, intravaginal sponges containing progestogens are widely recognized as effective for estrus synchronization during both breeding and non-breeding seasons (Abecia et al., 2012). However, during the non-breeding season, although ovarian follicular growth occurs, estrous expression is suppressed due to reproductive quiescence (Woodruff and Shea, 2011). In Lesotho, many Merino sheep farmers attempt to breed ewes during summer to ensure lambing in winter, when disease and parasite incidence is lower. However, because ewes are seasonal breeders, they are often difficult to mate outside autumn, when natural conditions favor reproduction. Farmers in Lesotho generally lack knowledge of synchronization protocols that could manipulate estrus and improve breeding efficiency. Consequently, reproduction is often poor and inconsistent. This study aims to provide evidence on the effectiveness of different synchronization protocols for Merino sheep during the non-breeding season. The findings will help farmers address seasonal breeding limitations, improve reproductive performance, and adopt more reliable strategies for flock management.

MATERIAL AND METHOD

Ethical Approval

The study was approved by the Ethics Committee of the Department of Animal Science, National University of Lesotho (NUL/AS-EC/2025/07) and conducted in accordance with Directive 2010/63/EU on animal research.

Study Area

The study was conducted at the National University of Lesotho (NUL) farm in Roma, Maseru district, Lesotho, located about 34 km southeast of the capital city, Maseru for a period of 10 months from October 2022 to July 2023. Roma lies at an altitude of 1,680 m and longitude 27.7° E. The region has a mean minimum temperature of 8.63°C, a mean maximum temperature of 23.51°C, and an average annual precipitation of 93.45 mm (Lesotho Meteorological Services, 2023).

Study Design

A total of 204 Merino ewes, each of which had lambed once and reached puberty, were randomly assigned to four treatment groups in a completely randomized design. Each treatment group included a total of 51 ewes, which were further subdivided into three replicate groups of 17 ewes each.

Synchronization Protocols

TRT A (Control): Ewes received no treatment and were inseminated whenever they exhibited estrus. TRT B (Sponges only): Intravaginal sponges were inserted for 12 days. After sponge removal, estrus was detected, followed by artificial insemination. TRT C (Double prostaglandin): Ewes received an intramuscular injection of 1 ml PGF2α on day 0 and again on day 11. Estrus detection and insemination followed. TRT D (Combination protocol): Sponges were inserted on day 0, followed by 1 ml PGF2α on day 12. On day 13, sponges were removed, and PMSG was administered. Estrus detection and insemination followed.

Management and Estrus Detection

Ewes with a body condition score of 2.5 or higher were included. Animals grazed on pasture for 6–9 hours daily with ad libitum access to water. They were dewormed using Prodose Orange (Virbac R.S.A., Pty Ltd). Seven apronized rams were used for estrus detection, introduced for two hours each morning and afternoon.

Data Collection

Data were recorded for: Estrus response: Proportion of ewes exhibiting estrus. Onset of estrus: Interval between treatment withdrawal and first accepted mating (Paula et al., 2018). Estrus duration: Interval between estrus onset and end of behavioral signs (Farrag, 2019).

Data Analysis

Data were analyzed using SPSS (Version 20.0). One-way ANOVA was applied to evaluate intervals from treatment withdrawal to estrus onset and end, as well as estrus duration. Means were separated using the least significant difference (LSD) test. Statistical significance was set at $p \leq 0.05$.

RESULTS AND DISCUSSION

The effect of different synchronization protocols on estrus activity was summarized in Table 1. Estrus response varied across treatments, ranging from 54.9% in the control group (TRT A) to 98.0% and 96.1% in ewes treated with intravaginal sponges (TRT B) and a combination of sponges, prostaglandin, and GnRH (TRT D), respectively. The ewes subjected to double injection of prostaglandin (TRT C) reported estrus response of 68.60 %. Although the overall treatment effect was not statistically significant ($P \geq 0.05$), responses in TRT B and TRT D were significantly higher than those in TRT A and TRT C ($P \leq 0.05$). These results suggest that while all hormonal treatments were effective in inducing estrus during the non-breeding season, protocols involving sponges alone or in combination with prostaglandin and GnRH yielded the most consistent and prolonged responses. The reduced responses in the control and double prostaglandin groups may reflect the seasonal breeding nature of ewes, which are prone to anestrus outside the breeding season. Similar observations were reported by Menchaca et al. (2010), who found higher estrus responses in hormone-treated groups compared to untreated controls, and by Martinez et al. (2015), who reported minimal responses in untreated ewes. The intervals from treatment withdrawal to the onset and end of estrus did not differ significantly among groups ($P \geq 0.05$). However, variability was evident, with TRT C showing the longest mean onset interval (46.3 h) compared to TRT D (30.9 h). This variation may be attributed to genetic and environmental differences among flocks, despite being of the same breed. Previous studies have reported shorter onset intervals of estrus between 0–3 days after sponge removal, and Mushap et al. (2022), who reported an average of 32 h. In contrast, the current findings are more consistent with those of Wildeus, (2000), who recorded onset times between 33–74 h following prostaglandin treatment. Estrus duration also differed across treatments (Table 1). Ewes in TRT B exhibited the longest mean duration (40.2 h), which was significantly higher ($P \leq 0.05$) than in TRT A (35.0 h). TRT C and TRT D showed intermediate values.

Table 1. Effect of different synchronization protocols on estrus activity

Parameters	Treatments			
	A	**B**	**C**	**D**
Number of ewes	51	51	51	51
Estrus response (%)	54.9^{b}	98.00^{a}	68.60^{b}	96.10^{a}
Interval from withdrawal of treatments to onset of estrus (h)	-	40:21 ± 1:58^{a}	46:28 ± 1:04^{a}	30:55 ±1:18^{b}
Interval from withdrawal of treatments to end of estrus (h)	-	79:16 ± 1:59^{a}	91:31 ± 3:42^{a}	69:02 ± 1:24^{a}
Duration of estrus (h)	35:03 ± 1:51^{b}	40:18 ±1:20^{a}	38:56 ± 1:22^{ab}	37:42 ± 1:32^{ab}

Means within a row with different superscripts are significantly significant ($P \leq 0.05$) and means within a row with different superscripts do not differ significantly ($P \geq 0.05$). A (Control), B (Intravaginal sponges), C (Double prostaglandin injection), D (combination of intravaginal sponges, prostaglandin and GnRH)

These results align with Fonseca et al. (2012), who reported shorter estrus periods following prostaglandin treatment, but contrast with Zhang et al. (2023) who observed longer durations. The observed variability in estrus duration may reflect differences in breed characteristics, hormonal responsiveness, and environmental influences, as also noted by Dixon et al. (2006).

Further analysis of estrus distribution across time intervals (Figures 1, 2 and 3) revealed significant associations ($P \leq 0.05$) between synchronization protocols and estrus expression patterns. TRT C achieved the highest proportion of ewes in estrus at 36–48 h post-treatment, while TRT D extended estrus expression up to 96 h, likely due to the added effect of GnRH on follicular development. These results suggest that while all hormonal treatments were effective in inducing estrus during the non-breeding season, protocols involving sponges alone or in combination with prostaglandin and GnRH yielded the most consistent and prolonged responses. Nevertheless, the variation observed indicates that factors such as age, health status, and environmental conditions, particularly photoperiod and temperature, continue to play a major role in reproductive performance of seasonally breeding ewes (Blaschi et al., 2014; Cadena-Villegas et al., 2015). The findings highlight that intravaginal sponges and combined protocols are more reliable in inducing estrus during the non-breeding season, while prostaglandin alone produced inconsistent results.

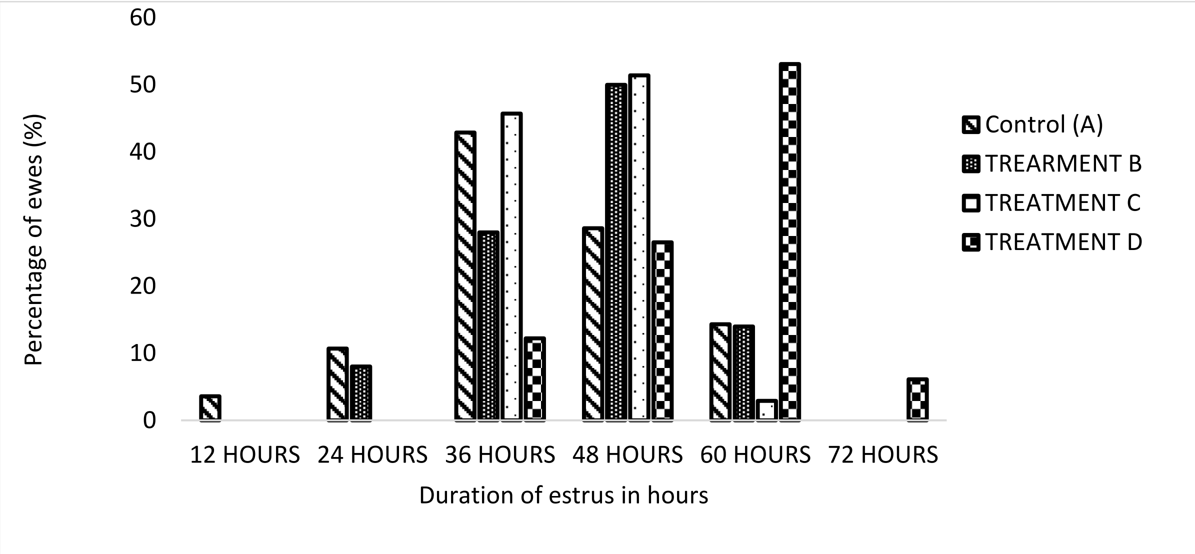

Figure 1. Estrus duration under different synchronization protocols

Overall, the findings highlight that intravaginal sponges and combined protocols are more reliable in inducing estrus during the non-breeding season, while prostaglandin alone produced inconsistent results. These outcomes support previous studies demonstrating the effectiveness of hormonal synchronization (Ozyurthy et al., 2010; Mirzaei et al., 2017), but also emphasize the need to account for seasonal, genetic, and management factors that influence estrus expression in sheep.

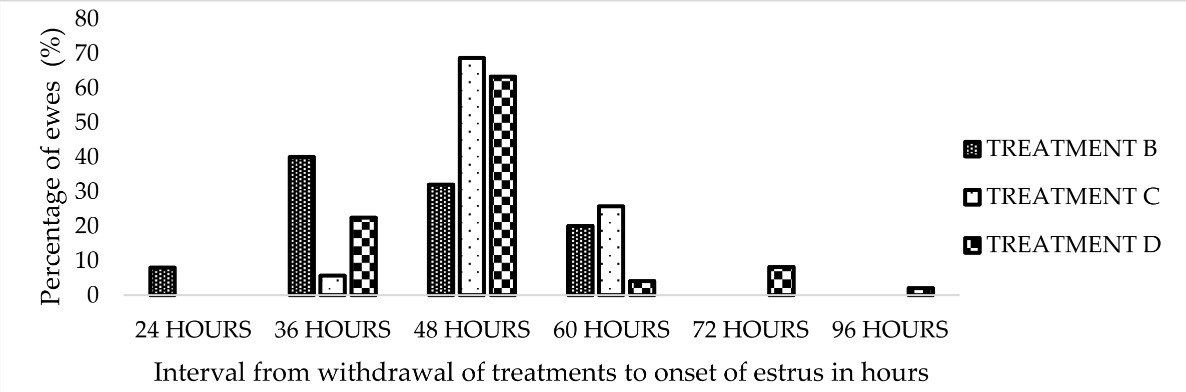

Figure 2. Interval from withdrawal of treatments to onset of estrus under different synchronization protocols

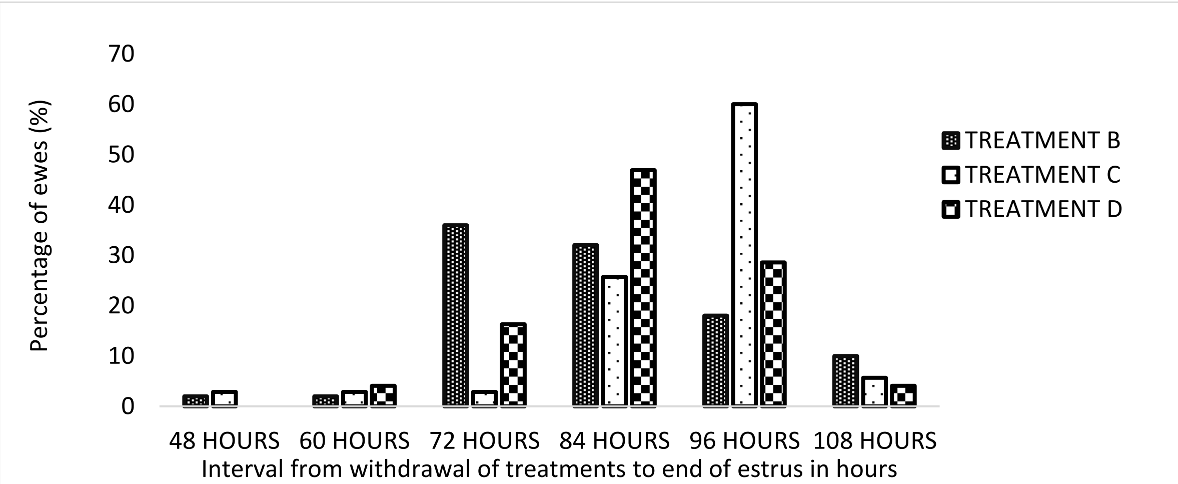

Figure 3. Interval from withdrawal of treatments to end of estrus in hours under different synchronization protocols

CONCLUSION and RECOMMENDATION

This study demonstrated that intravaginal sponges (TRT B) were the most effective treatment for inducing estrus, achieving a 98.0% response rate. The control group exhibited the shortest estrus duration (12 h), while TRT B produced the most rapid onset of estrus, with 8.0% of ewes cycling within 24 h of sponge removal. TRT C was most effective in shortening the interval between treatment withdrawal and estrus end. These findings suggest that sponge-based protocols, particularly in combination with prostaglandin and GnRH, can effectively overcome seasonal breeding limitations in Merino ewes. Adoption of these protocols in Lesotho could improve reproductive efficiency, enhance flock productivity, and provide farmers with reliable tools for managing non-breeding season reproduction.

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Conflict of Interest

The authors declare no conflict of interest.

Authors Contribution

PSL conceived and conducted the research, collected and analyzed the data, and prepared the initial draft of the manuscript. PMD contributed to data interpretation, critical review, and editing of the manuscript. SM provided guidance, technical input, and assisted in refining the final version of the manuscript. All authors read and approved the final manuscript.

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