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The Optimal Breeding Seasons for Awassi Ewes in Saudi Arabia's Central Region

Ahmed Ali[1,2*], Derar Derar[1,2], Abduulah S. Alwashmi[1] and Tamim Alhassun[3]

[1]Department of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Qassim University, Saudi Arabia
[2]Department of Theriogenology, Faculty of Veterinary Medicine, Assiut University, Assiut-71526, Egypt
[3]Ministry of Agriculture, Water, and Livestock, Saudi Arabia
***Corresponding author:** drahmedali@gmail.com

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ABSTRACT

This study aimed to investigate the most suitable breeding seasons for Awassi ewes in the central region of Saudi Arabia. To achieve this, two experiments were conducted. The first experiment measured and counted luteal and follicular structures in the different breeding seasons of the year. The second experiment focused on collecting reproduction data such as lambing, twining, and lamb mortality rates. The data obtained was then analyzed. The results revealed that the number of corpora lutea was greater in autumn and summer than in winter and spring ($P<0.05$). Ewes had more small, medium, and large follicles in summer than in other seasons ($P<0.05$). Lambing rates were significantly higher in summer and autumn-mated ewes than in winter and spring-mated ewes ($P<0.05$). Twining rates in autumn-mated ewes were greater than in other seasons ($P<0.05$). Lambing rates were higher on farms that used one breeding season per year than on farms that used two breeding seasons per year ($P<0.05$). Lamb mortality rates did not differ between seasons. In conclusion, summer and autumn provide the optimal environmental conditions for successful mating for Awassi ewes in the Saudi Arabian central region. With this knowledge, farmers in the region can plan and ensure maximum productivity.

Key words: Season; Ovarian activity; Reproductive performance; Awassi sheep; Subtopics

INTRODUCTION

Sheep is a major meat producer in subtropical and arid regions (El Sabry et al. 2023). In small ruminants, reproductive efficiency is affected by seasonality, which is affected by breed and latitude (Simões et al. 2021). Awassi is the most common sheep breed in Middle Eastern countries and it is primarily used for meat, milk, and wool production (Epstein 1982; Talafha and Ababneh 2011; Haile et al. 2019). This breed retains deserving individuals, particularly those capable of adapting to harsh environments and management changes (Galal et al. 2008). Awassi sheep, on the other hand, is a low-producer breed (Ali et al. 2020) and reach puberty later than others (Kridli et al. 2007).

Photoperiod, atmospheric temperature, geographical location, and nutrition all influence seasonal variation in sheep reproductive performance (Faigl et al. 2011; Menassol et al. 2012; He et al. 2021; Vlčková et al. 2022; Zieba et al. 2022). It has been thoroughly established that temperate sheep are mostly seasonal breeders, whereas those from tropical regions exhibit reproductive activity all year (Arroyo et al. 2016; Batailler et al. 2018). The state is less vibrant for subtropical sheep, whose seasonal variations in length and intensity of light are not as pronounced as they are at high latitudes (Ali et al. 2006; Ali and Hayder 2008; Talafha and Ababneh 2011). As a result, determining the most appropriate breeding season requires studying seasonality in ovarian activity and the reproductive performance of subtropical breeds.

Reproductive performance is one of the most influential factors in determining sheep flock production efficiency (Ali et al. 2009; 2020). Awassi ewes have low reproductive performance. Only about 10% of Awassi ewes lamb twice a year (Lafi et al. 2009; Ali et al. 2020). Twining rates varied between 4 and 20% (Epstein 1982; Lafi et al. 2009; Ali et al. 2020). Pregnancy/lambing rates ranged from 65 to 79% (Lafi et al. 2009; Ali et al. 2020).

Each Middle-East country has its own breeding season for Awassi sheep. Estrus peaks in Lebanon in August and September; the main lambing season in Iraq is in November; in Turkey, 25.47 and 35.24% of ewes give birth in December and January, respectively. The breeding season in Syria is from December to January; and the

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breeding season in Jordan begins in April and lasts until September (Epstein 1982; Zarkawi 1997; Talafha and Ababneh 2011; Gül et al. 2020). This pattern of estrus peaks and lambing seasons is consistent across the region, suggesting supportive environmental conditions. There is no information available about the most suitable breeding season for Awassi ewes in Saudi Arabia. This study was designed to determine when Awassi ewes breed best in Saudi Arabia's central region.

MATERIALS AND METHODS

Experiment I: Estimation of seasonal ovarian activity variation

Over the course of one year, 538 Awassi ewes (age >4 years) were collected from local abattoirs in Qassim region (longitude 43-58°E; latitude 21-26°N, Fig. 1). The average temperature and humidity were 38.3±0.3ºC and 10.1±0.3% in summer; 29.7±3.5ºC and 25±7.2% in autumn; 18ºC and 36 ± 0.6% in winter; and 27.7±4.1ºC and 21.3±1.2ºC, respectively. Follicular and luteal structures were meticulously measured. Follicular populations were divided into three groups: small (SF, 3mm in diameter), medium (MF, 3-5mm in diameter), and large (LF, >5mm in diameter) (Ali et al. 2006). Data were categorized by examination season (Summer, n=97; Autumn, n=175; Winter, n=149; Spring, n=117).

Experiment I1: Determination of lambing, twining, and lamb mortality rates

Reproduction data including lambing rate (the number of lambs born per ewe mated), twining rate (the proportion of twin births in a given season out of the total number of births in this season), as well as lamb mortality rate (pre-weaning mortality), were collected from 80 sheep farms containing 22042 ewes during 146 breeding seasons at Qassim region. Most sheep were kept in a closed system and fed primarily alfalfa (*Medicago sativa*) and barely.

Statistical analysis

The data were presented as a mean±SE. ANOVA was used to compare numerical data across seasons, with Fisher's least significant difference (LSD) as the post-ANOVA test. Chi-square was used to examine percentages for differences between categories. The significance level was set at $P<0.05$. For analysis, the SPSS program, version 23 (2015), was applied.

RESULTS

The proportion of corpora lutea/ewe was higher in autumn and summer than in winter and spring (Table 1). Furthermore, the number of small, medium, and large follicles was more in summer than in other seasons ($P<0.05$). Ewes with no corpus luteum were more common ($P<0.05$) in winter (46.3%) and spring (51%) than in summer (18.2%) and autumn (21.1%). The proportion of ewes with ≥ two corpora lutea was much higher ($P<0.05$) in autumn (34.9%) and summer (29.1%) than in winter (18.2%) and spring (17%).

Six breeding programs were observed in sheep farms in Qassim region: summer and winter (n=58 farms, 72.5%), summer (n=12 farms, 15%), summer and autumn (n=5 farms, 6.25%), summer and spring (n=2 farms, 2.5%), winter (n=2 farms, 2.5%), and autumn and spring (n=1 farm, 1.25%).

The lambing rate was 73.68% on average, and it was significantly higher ($P<0.05$) in summer and autumn-mated ewes than in winter and spring-mated ewes (Table 2). The twinning rate was 12.82% on average, and it was higher in autumn-mated ewes than in other seasons-mated ewes. The lambing rate was greater on farms with one breeding season per year than on farms with two breeding seasons per year ($P<0.05$), but the twining rate was unaffected (Table 3).

There was no seasonal variation in lamb mortality rates, which averaged 16.94%. The most common signs associated with mortality were general lethargy (66.7%), diarrhea (44.4%), refusal to suckle (33.3%), poor management (33.3%), infectious diseases (11.1%), and neurological symptoms (11.1%).

DISCUSSION

According to current data, Awassi ewes in Saudi Arabia's Qassim region are almost cyclic throughout the year, with a clear increase in summer and autumn. When these results are compared to those of other Middle Eastern countries (Epstein 1982; Zarkawi 1997; Talafha and Ababneh 2011; Gül et al. 2020), it becomes clear that there are significant differences between ewes from one region to the next. These findings pave the way for further research into the role of daylight in the initiation of ovarian activity in sheep breeds in subtropical areas. Subtropical sheep breeds have different photoperiodic sensitivity. Feed availability throughout the year may also play a role in the year-round continuation of ovarian activity (Menassol et al. 2012; Senosy et al. 2017; Martin 2022). This further research could uncover how photoperiodic sensitivity and feed availability interact to influence ovarian activity in sheep breeds in subtropical areas.

The season also affected the Awassi ewe follicular population, with autumn and summer having the highest numbers. Similarly, subtropical fat-tailed ewes had higher ovarian activity between August and January than in February and July (El-wishy 1984). Autumn, like the current finding, was the most appropriate season for CL function in Ossimi lambs in the subtropics (Ali et al. 2006). Melatonin could play a role in this seasonal ovarian activity variation. Melatonin, secreted by the pineal gland, influences GnRH, LH and FSH (Misztal et al. 2002). Subcutaneous melatonin implants are widely used to improve reproductive efficiency during non-breeding seasons (Haresign et al. 1990; Kumar and Purohit 2009; Barbanoj and Abecia 2022). Furthermore, there is compelling evidence that kisspeptin-containing neurons in the arcuate nucleus coordinate GnRH pulse secretion in ewes (Nestor et al. 2018). In seasonally acyclic ewes, kisspeptin treatment results in ovulation (Clarke and Caraty 2013; Beltramo and Decourt 2018).

Several factors, according to Awassi sheep breeders, influence the choice of mating season, including the appropriate environmental conditions for newborns, the possibility of a second lambing in the same year, the libido and stamina of the rams, and the health status of the ewes. Based on the present findings, most breeders expose ewes for mating in the early summer to obtain births in the autumn

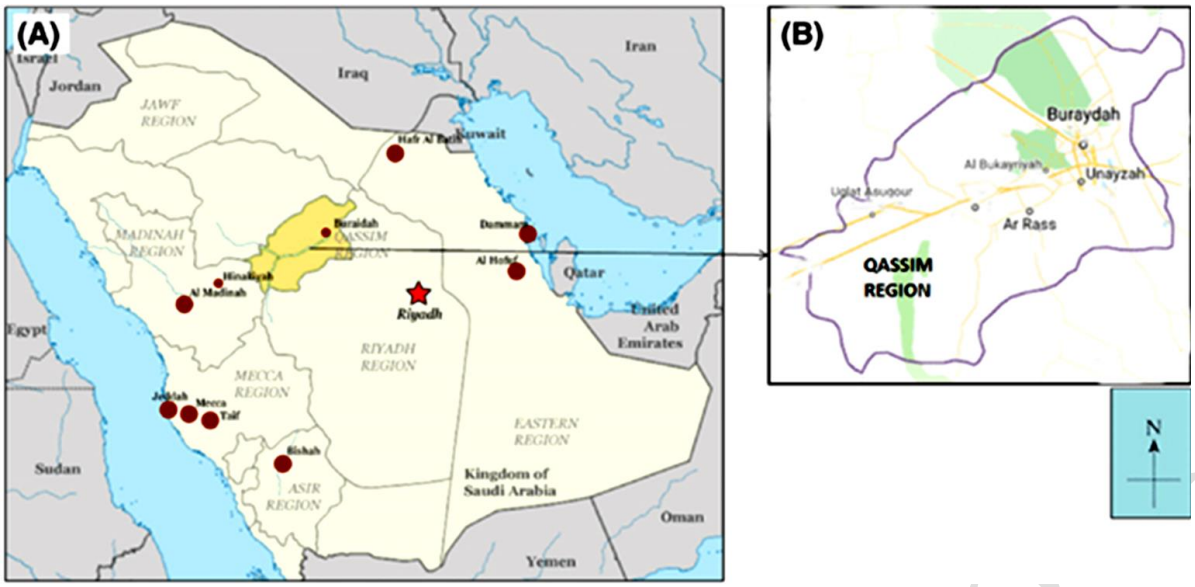

Fig. 1: Location of Qassim region in Saudi Arabia.

Table 1: Seasonal variation of the ovarian activity in Awassi sheep

Breeding Season	Ewes (Number)	Number of corpora lutea/ewe	Number of small follicles (< 3mm in diameter)/ewe	Number of medium follicles (3-5mm in diameter)/ewe	Number of large follicles (>5-10mm in diameter)/ewe
Summer	97	0.99±0.08a	10.6±0.8a	2.72±0.28a	0.86±0.12a
Autumn	175	1.19±0.06a	4.7±0.34b	1.26±0.21b	0.28±0.05b
Winter	149	0.74±0.07b	7.6±0.41c	1.22±0.11b	0.31±0.05b
Spring	117	0.67±0.07b	8.78±0.51c	1.11±0.1b	0.37±0.07b

Values (mean±SE) with different letters in the same column differ significantly (P<0.05).

Table 2: Effect of the breeding season on lambing, twining, and lamb mortality rates in Awassi ewes

Breeding season	Number of observations	Lambing rate (%)	Twining rate (%)	Lamb mortality rate (%)
Summer	78	86.6±1.3a	12.8±1.8a	18.22±6a
Autumn	5	92±5.6a	32±16.6b	19.25±5.6a
Winter	60	75±2.5b	11.5±1.6a	14.71±4.1a
Spring	3	40±7.6c	7.3±3.4a	16.93±2.7a

Values (mean±SE) with different letters in the same column differ significantly (P<0.05).

Table 3: Effect of number of breeding seasons per year on lambing and twining rates in Awassi ewes.

Number of breeding seasons/year	Number of observations	Lambing rate (%)	Twining rate (%)
One breeding season/year	14	95.1±1a	11.4±3.2a
Two breeding seasons/year	132	71.4±1.8b	13±1.4a

Values (mean±SE) with different letters in the same column differ significantly (P<0.05).

(when newborns have a better chance of survival), and the ewes can be exposed for mating in the winter of the same year after two or three months (weaning period). Epstein (1982) reported that grazing conditions significantly affect Awassi flock breeding seasons. The ewes exhibit high sexual activity only after spring and summer grazing restores the weight lost during the previous period. Another reason is that many Saudi sheep breeders prefer that lambs sacrificed on Eid al-Adha be older than six months old. This suggests that the proper timing of the breeding season is closely linked to the availability of food and the local farmer's preferences for the age of lambs for sale.

Lambing rates were higher among ewes that mated in the autumn and summer. This accurately reflects the seasonal increase in ovarian activity. In a similar study in the subtropics, the lambing rate was higher in Farafra ewes mated in late spring than in ewes mated in winter (Ali and Hayder 2008). Following late spring mattings, placental size, fetal growth, and P4 concentration were decreased (Ali and Hayder 2008). Summer heat stress may cause a temporary impairment in placental size and function, resulting in a transient decrease in fetal growth rate (Ali and Hayder 2008). In Awassi ewes, Kridli et al. (2007) and Ali et al. (2020) reported lambing rates ranging from 79 to 90%. Furthermore, these lambing rates indicate the overall success of the reproduction cycle, despite the potential impacts of summer heat stress.

Twining rates in Awassi ewes are too low compared to other sheep breeds, ranging from 4 to 20% (Epstein 1982; Gootwine et al. 2008; Ali et al. 2020; Ali and Derar 2021). The twinning rate is a complex trait influenced by genetic and environmental factors. Major genes (BMP15 and BMPR-IB) can enhance ovulation rates in sheep flocks around the world (Montgomery et al. 2001). These genes regulate granulosa cell maturation and follicular size in the ovary (McNatty et al. 2003). Nutritional flushing may also boost ovulation rates. Scaramuzzi et al. (2006) found that short-term nutritional flushing increased blood insulin and leptin concentrations, as well as FSH hormone and intraovarian folliculogenesis. Exogenous gonadotropins

administered prior to or following progesterone sponge withdrawal increased ovulation rate and fecundity in subtropical Ossimi ewes with small litter sizes (Ali 2007). Thus, nutritional flushing combined with other management practices such as gene selection and exogenous hormone administration can enhance twinning rates in Awassi ewes (Scaramuzzi et al. 2006).

Several studies have reported average mortality rates ranging from 12 to 16% (Dwyer 2008), which are roughly comparable to this study. Lamb mortality has been linked to birth trauma, failure to adapt to post-natal life, inability to maintain body temperature, low lamb potency, a poor maternal bond, infectious disease, and functional disorders (Dwyer 2008; Holmøy et al. 2017; Horton et al. 2019). However, Shelton and Willingham (2002) found that 38-68% of lamb deaths were inconclusive. Lamb survival rates at birth were 98% for singles, 92% for twins, 86% for triplets, 78% for quadruplets, and 65% for quintuplets (Gootwine et al. 2008). Poor weather can significantly increase lamb losses during lambing, whereas shelter reduces these losses (Vialoux 2020). Because mortality is caused by a variety of factors, finding a solution is not always easy. As a result, keeping mortality records is critical to help identify potential causes and solutions. Additionally, proper nutrition, housing, and management practices can increase survival rates. Finally, providing adequate medical care and prompt attention to sick lambs can reduce mortality.

Conclusion

The results of this study will help breeders in the region better understand the most suitable breeding season for their flocks. This will maximize their productivity. Furthermore, the findings of this experiment can also help to inform and guide efficient management practices for Awassi flocks in the central region. This will lead to increased production and profitability.

Authors' contributions

Ahmed Ali: conceptualization; data analysis; investigation; writing - original draft. Derar R Derar: investigation; writing – review and editing. Abduulah S. Alwashmi: materials collection; investigation. Tamim Alhassun: Data collection.

Conflict of interest

The authors declare that they have no conflict of interest.

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