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Original article

Effects of age of Awassi ewes crossed with Hamdani rams on reproductive and wool characteristics

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ABSTRACT

This study was conducted in Al-Taji District, north of Baghdad, Iraq, on a privately managed sheep farm specializing in animal breeding. The objective was to evaluate the impact of ewe age on wool characteristics and reproductive performance in hybrid sheep produced by crossing Awassi ewes (n= 70) with Hamdani rams (n= 17). Records from the sires (Hamdani rams, originally from Mosul) and dams (Awassi ewes from Baghdad) were used. Reproductive data were first analyzed, including litter size and sex ratio. The total number of lambs born was 90, comprising 50 males and 40 females, with respective percentages of 55.6% and 44.4%. The Chi-square (χ^2) value was 4.50, indicating a significant difference at the $p \leq 0.05$ level. The mean litter size was 1.30 lambs per ewe, which was not statistically significant. Wool characteristics were measured in a subset of 43 ewes, distributed across age groups ranging from 1.5 to 5 years, with 5 animals per group. Significant differences ($p \leq 0.05$) were observed in raw fleece weight, with the highest average (2,234 g) recorded in 3.5-year-old ewes. Clean fleece weight also differed significantly ($p \leq 0.05$), with the highest value (2,060 g) found in 2-year-old ewes. However, no significant differences were recorded for fiber length or fiber diameter.

Keywords: Awassi ewes, Hamdani rams, raw wool, clean wool, fiber length, fiber diameter, litter size

INTRODUCTION

Sheep breeding is a seasonal activity, presenting ongoing challenges to optimizing productivity (Fathy *et al*., 2018). Profitability in sheep farming largely depends on improving reproductive performance, particularly through increased lambing rates (Tesema *et al*., 2020; Al-Jaryan *et al*., 2023; Alkhammas *et al*., 2023). One common strategy for genetic improvement is crossbreeding, which can enhance traits such as litter size and wool production. In Iraq, crossbreeding between Awassi and Hamdani sheep is increasingly used for these purposes (Fadel and Al-Shuhaib, 2022; Imran and Al-Thuwaini, 2024).

The Hamdani breed is primarily found in northern Iraq, particularly in Mosul, Erbil, and surrounding regions. It is valued for its milk, meat, and wool production (Al-Dabbagh, 2019). Globally, although wool production is still a focus in some countries, many sheep are now bred primarily for meat and milk. Industrial wool production is dominated by Australia and China, accounting for 24% and 15% of global output, respectively, followed by New Zealand (10%), South Africa (2.6%), and both the United Kingdom and Argentina (2%) (Anonymous,

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2020). Key indicators of wool quality include cleanliness, grease content, fiber length, tensile strength, and flexibility (Li *et al*., 2016; Bağkesen and Koçak, 2018; Singh *et al*., 2018; Murphy *et al*., 2019; Atav *et al*., 2022). Reproductive traits, such as litter size and reduced mortality, are also essential for productivity, and both can be improved through selective breeding and crossbreeding strategies (Hussein, 2024).

This study aimed to assess the impact of ewe age on wool characteristics and reproductive performance in hybrids produced by crossing Awassi ewes with Hamdani rams. Previous research has suggested that Hamdani sheep have a higher wool production potential compared to the Awassi breed. Hussein *et al*. (2023a, 2023b, 2024) and Hussein (2024) emphasized the role of crossbreeding in enhancing productivity in farm animals, especially when supported by improved environmental conditions, good-quality feed, and efficient energy utilization (Hussein and Hassan, 2019).

MATERIALS AND METHODS

This study was conducted on a randomly selected sample from a flock of hybrid sheep produced by crossbreeding Awassi ewes (n= 70) with Hamdani rams (n= 17). The flock was located on a privately owned farm in Al-Taji district, north of Baghdad, Iraq. The farm is managed by a team of agricultural engineers specializing in animal production, including breeding and nutrition, and is supported by veterinarians responsible for animal health and disease management. The aim of the study was to evaluate the effect of ewe age on wool characteristics and reproductive performance in Awassi ewes crossed with Hamdani rams. Data for this study were obtained from the records of hybrid rams, their Hamdani sires, and Awassi dams. The study focused on specific physical wool characteristics, including raw fleece weight, clean fleece weight, fiber length, and fiber diameter.

Wool samples were collected from 43 hybrid ewes. Raw fleece weight was measured using a standard balance and recorded in grams. The wool was then oven-dried at a temperature of 20 ± 2°C and relative humidity of 65 ± 2%, instead of being air-dried at room temperature. After drying, the wool was washed using antiseptic agents and washing powder followed by complete drying without moisture reconditioning. Each sample was then reweighed to determine clean fleece weight. Fiber length of the clean wool was measured using a standard ruler in accordance with AS (1978). Clean wool samples were then stored in a ventilated room to equilibrate moisture before a tuft was taken from each for fiber diameter measurement. Fiber diameter was assessed using an anmeter (AS, 1978), without differentiating between wool types (coarse or fine).

Information on the Hamdani sires (n= 17; aged 3-5.5 years) and Awassi dams (n= 70; aged 2.5-5 years) was obtained from the station's breeding records. Genital characteristics and reproductive performance data were extracted from these records. Litter size (i.e., the number of lambs born per parturition) was calculated using the formula described by Mirzaei *et al*. (2017):

$$\text{Litter size} = \frac{\text{number of lambs born}}{\text{number of ewes}}$$

Statistical analysis

Data on wool characteristics and reproductive performance were obtained from station records, specifically for lambs born from Awassi ewes crossed with Hamdani rams. Wool trait measurements included raw fleece weight, clean fleece weight, fiber length, and fiber diameter. The total number of dams included in the study was 70, and the number of sires was 17. Offspring data were collected from 43 hybrid ewes. The data were analyzed using the Statistical Analysis System software (SAS, 2012) to evaluate the effect of ewe age on lambing performance and wool characteristics. Means were compared using Duncan's Multiple Range Test (Duncan, 1955), based on the Least Squares Means method. The statistical model used was as follows:

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$$Yijk = \mu + Gi + Aj + eijk$$

Where:

Yijk= observed value

μ= general mean

Gi= genetic group (Awassi ewes crossed with Hamdani rams).

Aj= effect of age.

eijk= random error that is normally distributed with a mean of zero and two bits σ2e.

RESULTS

In this study, data on the reproductive characteristics of Awassi ewes and Hamdani rams (Table 1) were obtained from the private records of an animal station. A total of 17 rams aged between 3 and 5.5 years and 70 ewes aged between 2.5 and 5 years were included. The total number of newborn lambs was 90, comprising 50 males (55.6%) and 40 females (44.4%), with a Chi-Square (χ^2) value of 4.50 indicating a statistically significant difference ($p \leq 0.05$). The average litter size was 1.30 ± 0.08 lambs per birth, which was not statistically significant. The highest litter size observed was 1.60 lambs per birth, recorded in ewes aged 4 years mated with rams aged 4.5 years.

Table 1 Effect of age of Awassi ewes crossed with Hamdani rams on reproductive characteristics

age of ewes (year)	no. of ewes	age of rams (year)	no. of rams	no. of newborn	sex of newborn		litter size (lambs/birth)
					male	female	
2.5	13	3	3	16	10	6	1.23
3	11	3.5	2	15	7	8	1.36
3.5	14	4	3	14	9	5	1.00
4	10	4.5	4	16	8	8	1.60
4.5	11	5	3	13	5	8	1.18
5	11	5.5	2	16	11	5	1.45

The results demonstrated the influence of age on specific physical wool characteristics in hybrid sheep produced by crossing Awassi ewes with Hamdani rams (Table 2). A total of 43 ewes were studied, with ages ranging from 1.5 to 5 years. A statistically significant difference ($p \leq 0.05$) was observed in raw fleece weight, with the highest average (2,234 g) recorded in 3.5-year-old ewes. Clean fleece weight also showed significant variation ($p \leq 0.05$), with the highest value (2,060 g) found in 2-year-old ewes.

Although no significant differences were observed in wool fiber length WOL) or fiber diameter (FDI), the mean fiber length recorded were 11.85, 12.95, 12.10, 12.30, 12.90, 13.01, 12.70 cm for animals aged 1.5, 2, 2.5, 3, 3.5, 4, and 5 years, respectively. Correspondingly, the mean fiber diameters were 31.20, 32, 32.02, 31.56, 31.90, 32.35, 31.50 μm for the same age group.

Table 2 Effect of age in Awassi ewes crossed with Hamdani rams on selected wool characteristics

age of ewes (year)	no. of ewes	average ± standard error			
		WRFL (g)	WCFL (g)	WOL (cm)	FDI (μm)
1.5	5	2,090 ± 69.64 ^{e}	1,900 ±79.05 ^{g}	11.85 ± 0.33	31.2 ± 0.58
2	7	2,186 ± 27.31 ^{c}	2,060 ± 36.74 ^{a}	12.95 ± 0.42	32.0 ± 0.50
2.5	6	2,040 ± 99.24 ^{g}	1,920 ± 106.77 ^{d}	12.10 ± 0.32	32.02 ± 0.25
3	8	2,055 ± 88.17 ^{f}	1,917 ± 111.67 ^{e}	12.30 ± 0.36	31.56 ± 0.18
3.5	4	2,234 ± 51.53 ^{a}	1,910 ± 183.30 ^{f}	12.90 ± 0.30	31.90 ± 0.33

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4	6	2,160 ± 79.68 [d]	1,995 ± 75.99 [c]	13.01± 0.35	32.35 ± 0.41
5	7	2,190 ± 64.03 [b]	2,050 ± 74.16 [b]	12.70 ± 0.28	31.05 ± 0.32

Different superscript letters within the same column indicate significant difference ($p \leq 0.05$); WRFL: raw fleece weight; WCFL: clean fleece weight; WOL: wool fiber length; FDI: fiber diameter.

DISCUSSION

The reproductive characteristics recorded in this study, particularly the average litter size (1.30 ± 0.08 lambs/ewe), suggest that crossbreeding Awassi ewes with Hamdani rams may enhance reproductive efficiency. This value is higher than those reported in some previous studies on purebred Awassi sheep, such as Hussein (2024), indicating potential heterosis (hybrid vigor) resulting from the cross. Moreover, the observation that 4-year-old ewes mated with 4.5-year-old rams produced the highest litter size (1.60 lambs/ewe) underscores the importance of optimal reproductive age for both sexes in maximizing fertility.

Crossbreeding has long been utilized to enhance traits such as litter size, growth rate, and adaptability. The genetic combination of Awassi, known for milk production and adaptability to arid environments, with Hamdani, known for wool and meat traits, appears promising. Al-Jabbar and Al-Thuwaini (2024) emphasized the role of genetic variation in reproductive traits, while Fadel and Al-Shuhaib (2022) pointed out the mitochondrial and geographical differences that may contribute to variability in performance between breeds. This study adds to that body of evidence by demonstrating how targeted crossbreeding can improve reproductive traits without compromising wool quality. Imran and Al-Thuwaini (2024) also noted that traits such as birth weight, twin rates, and number of days to parturition are affected by genetic background. The current results support the concept that selective crossbreeding can enhance reproductive performance and productivity in sheep.

Regarding wool characteristics, the significant differences in raw fleece weight (WRFL) and clean fleece weight (WCFL) among age groups align with previous research by Behrem and Gül (2022), which noted age-related changes in fleece traits. In our study, 3.5-year-old ewes produced the heaviest raw fleece (2,234 g), suggesting that this age may represent a peak in wool production for hybrids. Interestingly, 2-year-old ewes yielded the highest clean fleece weight (2,060 g), indicating that younger animals may produce finer, cleaner fleece, possibly due to better skin condition or lower exposure to environmental contaminants.

No significant differences were found in wool fiber length (WOL) or fiber diameter (FDI), which suggests that these traits may be more genetically stable or less responsive to the age of the ewe. The consistency of these values across age groups implies that selection for fiber quality in this hybrid population may require genetic, rather than management or age-based, interventions. It also indicates that while total wool yield may increase with age, the structural quality of wool fibers remains relatively constant, which is advantageous for maintaining product consistency in textile applications.

Collectively, the findings support the idea that age and genetic background interact to influence wool yield traits, while fiber quality traits may be under stronger genetic control. Additionally, reproductive efficiency appears to benefit from crossbreeding and optimal pairing of ewes and rams within specific age ranges.

These results have practical implications for sheep producers in Iraq and similar environments, where maximizing both reproductive output and wool production is critical to farm profitability. Strategic management that considers ewe age, ram pairing, and breed combinations can contribute to improved productivity and economic return.

CONCLUSIONS

Based on the findings of this study, it can be concluded that crossbreeding between Awassi ewes and Hamdani rams contributed to an

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increase in litter size and improved overall reproductive efficiency, accompanied by a reduction in lamb mortality. This enhancement in reproductive performance supports the use of targeted crossbreeding as a strategy to boost flock productivity. Additionally, ewe age was found to have a significant influence on wool production, particularly affecting raw and clean fleece weights. However, no significant age-related differences were observed in wool fiber length or diameter, indicating that while wool yield may increase with age, fiber quality remains relatively stable. These findings suggest that managing ewe age in hybrid flocks can optimize wool output without compromising quality.

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AUTHOR'S CONTRIBUTIONS

The research and writing of this article were solely conducted and prepared by the author.

CONFLICT OF INTEREST

The author declares no conflict of interest related to the content or publication of this article.

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