Breeding season and body condition influence on zootechnical parameters of Ouled Djellal ewes in semi-arid areas

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Abstract

In this study, a database was created by monitoring 3000 Ouled Djellal ewes, belonging to ten breeding farms and representing two modes of reproduction management. The data collected make it possible to measure the reproductive performance of females and to determine the influence of non-genetic factors on different parameters. The Body Condition Score (BCS) was calculated to compare performance in relation with breeding conditions. The results showed that fertility and prolificacy accounted for 91.1±0.1% and 116.4±0.2% in the reproduction mode respectively based on one lambing/year with exclusive spring control, and of 53.5±0.2% and 101.2±0.1% respectively in the traditional lambing system spread over the year (with the ram permanently present in the flock) (P<0.05). The BCS varied according to mating season and feeding system. Indeed, as the BCS at mating increased, fertility, prolificacy and productivity improved. Ewes whose BCS at mating was equal to or greater than 3 obtained the best performance, while those with a lower BCS were less fertile, less prolific, and less productive. The average productivity of Ouled Djellal sheep was 107.0±0.1%, and 54.8±0.3%, respectively, in the first and second mode of reproduction management (P<0.05). This study highlights the main sources of variations and their interactions.

Key words: *local sheep; breeding system; performance; semi-arid climate*

Introduction

In different production systems, breeding profitability expressed by productivity is a major concern of sheep farming worldwide (Belhadia et al., 2020; Zidane et al., 2021). Its improvement constitutes an important objective for the ovine meat production industry. Sexual activity and reproductive performance of ewes are affected by environmental factors, mainly the photoperiod. In certain breeds considered non-seasonal, whose habitat is situated near the equator, low sensitivity to photoperiodic factors enables females to maintain sexual cycles for most of the year (Đuričić et al., 2021). This is particularly the case for the Ouled Djellal sheep

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breed in Algeria, which express little or no seasonal anoestrus (Taherti and Zidane, 2023).

In Algeria, sheep farming is located mainly in arid and semi-arid regions, and represents an important source of animal protein (Ait Issad et al., 2022). Many authors testify to the good reproductive qualities of Ouled Djellal breed, its good maternal behaviour and especially its exceptional resistance to environmental conditions (Dekhili, 2014; Zidane and Ababou, 2017). These qualities contribute to the increase of productivity, thus obtaining good meat results. However, many factors can affect zootechnical performance: low level of technicality, impact of restrictive climate conditions, insufficient quantity and quality of fodder, and poor breeding management. These obstacles prevent the full reproduction potential to be fully achieved, particularly due to poor nutritional preparation of females around the reproduction period (Arbouche et al., 2013; Adaouri et al., 2022). Meat production improvement in the Ouled Djellal breed requires studies on the potential of animals, in particular the reproduction management effects on production and the analysis of interactions. Thus, research is required to precisely determine the associated performances. In this context, the present study aimed to describe the main reproduction parameters of this breed, performed according to two reproduction modes: one lambing/year mode with a spring reproduction season, and a lambing mode spread throughout the year.

Material and methods

Study area description

The study was conducted in Chlef region (latitude of 36°N) in northern Algeria, 200 kilometres from the capital Algiers. This region is known for its semi-arid Mediterranean climate. The rainfall during the experiment (in 2022) was 155 mm. The rainy season extends from November to February, with a maximum recorded from December to February. The average minimum temperature was 10.6°C in December and maximum 40°C in August. The amplitude of the photoperiod varies between 10h15min of minimum illumination per month in January and 14h50min of maximum illumination per month in June. The relief is flat overall. Livestock farming in the region is extensive. Herd feeding is based on meadow and range grazing year round. In sheepfolds, dry fodder (straw and vetch-oats) is the basic ration of herds also year round. Supplementation based on barley concentrate is provided depending on the time of year and the physiological condition of the animals.

Experimental herd monitoring and management method

The study was carried out on a flock of 3000 Ouled Djellal ewes, belonging to 10 breeding farms, representing two predominant modes of reproduction applied in more than 95% of the study region:

– **Mode 1**: management of an exclusive spring reproductive season and one lambing per year, represented by 5 farms, holding a total of 2065 ewes. The females were put into natural mating after simple isolation of the rams from the ewes. Indeed, outside of this period from April until June, the rams were mixed with females in another building . The average mating rate varied on farms from 25 to 30 ewes per ram.
– **Mode 2**: lambing spread throughout the year, also represented by 5 farms, with a total of 935 ewes. In this tra-

ditional mode of management, rams were permanently present in the herd. The number of rams per ewe also varied by farm from 55 to 70 ewes per ram.

Rams were of the same genetic type as ewes (Ouled Djellal breed) and from the mother breeding. Males were between 3 and 4 years old and females were between 2 and 5 years old. All herds underwent prophylactic measures: vaccination against enterotoxemia and ringworm and deworming against internal and external parasites. The available data on the quality of breeding stock revealed that the Ouled Djellal breed in the Chlef region is not highly sensitive to photoperiod variations. The ram produces significant quantities of sperm year-round (on average $4x10^9$ **± 0.30 sperm**atozoa/ejaculate) (Taherti et al., 2023).

Farms characteristics

Table 1 presents the characteristics of the monitored farms. These present a wide diversity of situations, identifiable in particular by the structure of livestock (such as herd size, forage areas, quantity of feed harvested and distributed, geographical location).

- **Mode 1 farms**: they have abundant food resources (harvested and pasturable fodder) ensuring self-sufficiency. Oat vetch and green barley represent the main fodder crops grown. Due to their geographic location (and nature of the soil), the yield per hectare is 85 to 90 quintals for oat vetch and 90 to 100 quintals to green barley. The availability of fodder guarantees a continuous adjustment between food supply and animal demand on these farms. Herd feeding is based year-round on oat vetch, green barley and a supplement (grain barley). The three main grazing resources are cereal stubble during the summer, fallow during the spring, and regrowth on stubble in the fall. This mode is represented on farms 1 to 5.
- **Mode 2 farms:** they have very limited surface areas and pastoral spaces. The quantities of fodder harvested

Table 1. Farm characteristics

Mode	Farm number	Age of owner (years)	Agricultural area (ha)	Forage area (ha)	Number of sheep	Livestock building
1	1	55	102	40	450	Modern
	2	40	225	52	750	
	3	61	80	22	150	
	4	52	750	85	550	
	5	35	95	31	165	
2	6	66	52	5	90	Precarious
	7	55	100	19	350	
	8	32	45	3	221	
	9	40	24	0	165	
	10	51	61	10	109	

are insufficient and the resources of usable grass on the ground in spring are very limited. On these farms, oat vetch is the main forage crop. Due to their geographic location (piedmont and mountain areas) and the nature of the soil, the yield of this crop is very low: 40 to 45 quintals/ha. The food system on these farms is predominantly pastoral. Sheep diet is based on uncultivated resources, particularly meadow and range grazing year-round. In sheepfolds, herd feeding is based on harvests of dry fodder (straw and vetch oats), which are very often insufficient and supplemented by small purchases of grain barley. This mode is represented on farms 6 to 10.

Data recording and parameters analysis

The breeding monitoring adopted in this year-long study made it possible to collect data from the 3000 ewes belonging to the two reproduction methods identified in the region. Monitoring included weekly and monthly visits. BCS was calculated monthly and during periods of mating.

Weekly breeding visits in the form of surveys and interviews allowed for observations, recordings, measurements and counting. The data collected made it possible to evaluate the following parameters relating to the reproduction of Ouled Djellal sheep, as previously described (Ammar and Lahsoumi, 2021):

- calving periods,
- fertility rate: number of lambing ewes/numbers of mated ewes x 100,
- prolificacy rate: number of lambs born/number of lambing ewes x 100,
- numerical productivity rate: number of weaned lambs/numbers of mated ewes x 100.

Fertility, prolificacy, and productivity results were expressed as a percentage (%). Data comparison was performed by the analysis of variance and all calculations were carried out using the XLSTAT software (version 2002). The differences detected were considered significant when $P<0.05$.

Body Condition Scoring (BCS)

In this study, 10 groups of 30 ewes were constituted on each farm (a total of 10 farms) to evaluate the BCS. The females chosen were representative of different age classes of the flock (between 2 and 5 years old), and were marked with ear tags. BCS was calculated according to the method of Russell et al. (1969), performed by two evaluators (technicians), and the value considered was the average of the two scores. Scoring was performed during April, May, June and September, October and

Table 2. Recommended Body Condition Scores for sheep (Calavas et al., 1998)

Physiological stage	Average grade	Observation
Mating	3 to 3.5	Effective supercharging if the score is between 2.5 and 3
Gestation	3 to 3.5	Possibly 2.5 for herds with very low prolificacy
Lambing	3.5	Score to achieve for prolific sheep
Lactation	2.5 to 3.5	Should not be below 2.5
Weaning	2 to 2.5	Never continue energy undernutrition beyond 8 weeks of lactation

Table 3. Cumulative results of the distribution of lambing according to management mode

	Mode 1		Mode 2			
	Spring breeding		Spring breeding		Autumn breeding	
	N	%	N	%	N	%
September	395	20.2	92	12.2	–	–
October	510	26.1	101	13.4	–	–
November	765	39.1	243	32.3	–	–
December	123	6.3	85	11.3	–	–
January	–	–	–	–	–	–
February	–	–	–	–	–	–
March	–	–	–	–	–	–
April	–	–	–	–	85	18.5
May	–	–	–	–	42	9.1
June	–	–	–	–	33	7.1
July	–	–	–	–	–	–
August	–	–	–	–	–	–

November, corresponding respectively to the spring and autumn breeding sessions (with two scorings per month). These key moments in the production cycle allow for the study of feed-production relationships and making a diagnosis of the breeding systems studied (for this, BCS recommended in literature is shown in Table 2). The results were collected monthly and the average of each production cycle was calculated.

Ethical Statement

All animal studies were conducted with the utmost regard for animal welfare, and all animal rights issues were appropriately observed. No animal suffered during the course of this study. All experiments were carried out according to the guidelines of the Institutional Animal Care Committee of the Algerian Higher Education and Scientific Research (Agreement Number 45/DGLPAG/DVA. SDA. 14).

Results

Repartition of lambing in the study area

Table 3 presents the distribution of lambing at the herd level in Chlef. Our data revealed that lambing in this zone was spread over 7 months, from September to June, indicating two very distinct lambing seasons. A more significant autumn lambing of 4 months running from September to December, and a lesser spring lambing of 3 months, running from April to June.

Analysis of the results of the lambing calendar according to management mode showed that the single autumn lambing session was a characteristic of mode 1 farms: of 1958 ewes put into breeding, 1793 ewes (*i.e.*, 91.7%) gave birth during the months of September to December. For mode 2 farms, the spread of lambing was not total and two lambing sessions were observed: a main

autumn session where approximately 69.2% of lambing (i.e., 521 ewes out of 752 lambing) took place during September to December, and a spring/summer session, less important represented by approximately 34.7% of lambing (*i.e.*, 160 ewes out of 459 ewes put into autumn lambing) during the months of April to June. It appears from these results that the herd on mode 2 farms was led according to a reproductive rhythm of a main breeding in spring, followed by a complementary session in autumn (69.2% of females were mated in spring compared to 34.7% in autumn). The differences observed between ewes bred and those having given birth were compared to the proportions of unfertilised females.

These results are justified by the state of cyclicity of females during the spring and by the ram effect, particularly in the herd of mode 1 farms. However, for the spring, three periods of fertilising mating corresponding to the three lambing periods, were noted. A first period, represented by the first month of lambing in September, corresponding to the first month of fertile mating in April. A second period, represented by the second and third months of lambing from October to November, corresponding to the second and third months of fertilising mating in May and June. Finally, a third period, represented by the last month of lambing in December, corresponding to the last month of fertile mating in July. Overall, according to the cumulative results of the distribution of lambing according to the three periods identified, lambing was more concentrated during the first and second lambing periods in the two management modes.

Table 4. Reproductive performances and average BCS of ewes in the two management modes by breeding season.

		Spring breeding (April-May-June)				Fall breeding (September-October-November)			
	Farm	BCS	Fertility (%)	Prolificacy (%)	Productivity (%)	BCS	Fertility (%)	Prolificacy (%)	Productivity (%)
Mode 1	1	3.7±0.9	93.1	125.0	116.9	–	–	–	–
	2	2.8±1.1	88.9	113.9	104.2	–	–	–	–
	3	3.4±0.7	94.7	108.0	101.4	–	–	–	–
	4	3.3±0.8	83.1	122.2	104.3	–	–	–	–
	5	3.1±0.9	95.5	111.9	108.7	–	–	–	–
Avg.		**3.3±0.9**	**91.1±0.1**	**116.4±0.2**	**107.0±0.1**	**–**	**–**	**–**	**–**
Mode 2	6	2.4±0.9	70.2	105.6	74.00	2.2±1.0	44--,2	100	44.2
	7	2.0±0.6	69.9	100.1	71.0	2.0±0.4	37.5	100	37.5
	8	2.5±0.4	73.4	101.8	75.5	2.2±0.6	35;6	100	35.6
	9	2.3±0.9	67.2	100.1	67.8	1.9±0.9	25.1	100	25.1
	10	2.0±0.7	70.5	105.0	76.9	2.1±0.5	40.0	100	40.0
Avg.		**2.2±0.6**	**70.6±0.1**	**102.5±0.9**	**73.04±0.3**	**2.1±0.1**	**36.4±0.3**	**100±0.1**	**36.5±0.3**

Table 5. Analysis of variance and comparison of means using the Ducan and Tukey test

	BCS	Prolificacy %	Fertility %	Productivity %
Spring mode 1	3.3[a]	91.1[a]	116.4[a]	107.0[a]
Spring mode 2	2.2[b]	70.6[b]	102.5 [b]	73.04[b]
Autumn mode 2	2.1[b]	36.4[c]	100[b]	36.5[c]
ANOVA (P Value)	<0.0001	<0.0001	<0.0017	<0.0001
R^2	0.85	0.95	0.57	0.92

The superscripts a, b, c refer to the variable average. Means that are significantly different according to the Ducan and Tukey tests are presented with different superscripts, while means that are not significantly different are presented with the same superscript.

Productivity and zootechnical performance of Ouled Djellal sheep

Table 4 shows the reproductive performance of the ewes monitored: fertility rate, prolificacy and productivity of Ouled Djellal sheep depending on their BCS and subjected to spring breeding in both modes. The overall average rates were 91.01±0.9, 116.4±0.2, 107±0.1 respectively for mode 1, and 70.6±0.1, 102.5±0.9, 73.04±0.3 respectively for mode 2.

For autumn breeding, the results were much less important than those of spring breeding and were 36.4±0.3%, 100±0.1%, and 36.5±0.3%, respectively for fertility, prolificacy and productivity.

From the statistical analysis of the results (Table 5), it appears that the prolificacy rate differed significantly from one mating season to another: 109.4% in spring and 100% in autumn (P<0.0017). However, the differences in fertility and productivity rates were highly significant (P<0.0001): 80.85.1% and 90.02% in spring vs 36.4% and 36.5% in autumn, respectively. Comparison according to management method showed that the fertility, prolificacy and productivity results were systematically higher with the management mode of one lambing per year with exclusive spring breeding (P<0.0001).

Indeed, Ouled Djellal sheep were more fertile when they had one lambing per year with only a spring reproductive session. The fertility rate was higher in mode 1: 91.04% compared to 53.5% (cumulative spring and autumn sessions) for mode 2 (permanent mating). The prolificacy results, although slightly higher in mode 1 (116.4% compared to 102% in mode 2), nevertheless remained statistically significant between the two management modes (P<0.0017). This demonstrates that the rate of reproduction did not have a very significant effect on prolificacy. Since only 57% of the difference (R^2 = 0.57) was explained by mode, other factors seem to influence prolificacy, notably the race factor.

BCS and reproductive performance

The scoring carried out during the study showed that the average BCS of ewes used for breeding differed depending on the farms, it varied from 1.9±0.9 to 3.7± 0.9. The BCS values of ewes on mode 2 farms were low during both production cycles (spring and autumn breeding). The highest BCS was 2.5±0.4 and 2.2±0.6 during spring and autumn sessions, respectively.

In mode 1 breeding, which practiced one lambing session per year, mating took place during a favourable period in terms of fodder (spring). The values recorded during this production cycle (between 2.8±1.1 and 3.7±0.9) were highly significant (P<0.0001). This difference in results between the two modes is explained at 85% (R^2=85) by the choice of management mode (rhythm of reproduction and feeding system) (Table 5). Indeed, in addition to grazing, breeders provided food support to the entire flock aimed at maintaining the condition of ewes and guaranteeing the success of the spring mating (flushing effect). The combination of grazing and supplementation (distribution of between 0.8 and 1.2 kg of barley/ewe/day) allowed better coverage of needs during the reproductive season.

The analysis of fertility, prolificacy and productivity of the females according to management mode and to BCS showed overall results to the advantage of mode1 farms. Ewes with good BCS (correctly fed) were more productive than those who were thinner. Indeed, in this study, the productivity rate of mode 2 ewes was 73.04±0.3% (spring breeding) and 36.5±0.3% (autumn breeding) for a BCS of 2.2±0.6 and 2.1±0.1, respectively. On the other hand, in mode 1 with an exclusive spring session, the productivity rate was 107±0.1%, for a BCS of 3.3±0.9.

Discussion

Comparing Ouled Djellal sheep to other meat breeds in Tunisia (particularly Barbarine and the Western Fine Tail), its productivity appeared low (0.9). Indeed, average productivity rates of 1.27 and 1.13 were reported for the Barbarine by Ben Gara (2010) and Brahmi et al. (2011), respectively, and 1.19 for the Western Fine Tail (Rekik et al., 2005). However, the comparison between the Ouled Djellal breed and the Taadmait breed in Algeria showed numerical productivity results close to 83% and 87%, respectively. In all the cases, this productivity remains below the recommended thresholds (> to 125%) for non-seasonal breeds (Dirand, 2017).

Placed under different breeding systems, Ouled Djellal sheep seem to exhibit different reproductive behaviours. Similar results were reported by Benyounes and Lamrani (2013) on the distribution of lambing of the Ouled Djellal ewe in the Skikda region of Algeria. Indeed, according to the results obtained, it clearly appears that during the year of study, high proportions of ewes had fertile mating only in spring, 91% and 70%, respectively in mode 1 and mode 2 breeding. Our data are in agreement with those of Adaouri et al. (2022). This is explained by the absence of deep anoestrus in the Ouled Djellal ewe, the effectiveness of the response to the male effect during the spring breeding, and by the good BCS of the females at this time, particularly those of mode 1 farms. The good response of the ewes after the introduction of rams during this period (case of mode 1), was the result of the high rate of females with "not very intense seasonal anoestrus" combined with a very adequate sex ratio (1 ram to 25 to 30 sheep). It was also undoubtedly due to the proportion of females even with deep anoestrus presenting good BCS (BCS in breeding = 3.3).

The low rate of lambing and therefore of fertile mating which was 34.7% recorded during autumn on mode 2 farms, was probably due to the lack of response of females to the male effect. These ewes were not able to resume their regular sexual activity to be bred and become pregnant. These results are generally similar with those reported by Arbouche et al. (2013) in the Djelfa region in Algeria.

Anoestrus can be explained by the particularly poor BCS during this period (BCS in breeding = 2.1). Indeed, the breeding in this system took place in a period of food shortage (pastoral resources and very limited supplementation), which results in a mobilisation of body reserves and a reduction in the BCS. Also, the transition of a category of females from lactation (lambing in spring) to mating in autumn and facing a food deficiency led to a drop in BCS. In this context, many studies reported that a weak BCS during breeding can lead to a delay in the manifestation of sexual activity, or even seasonal anoestrus (Boudebza et al., 2016). It is possible that during our experimental work there were females who expressed anoestrus or silent heat due to their weak BCS. Therefore, it seems necessary to obtain good performance from the ewes, to achieve a satisfactory BCS at the start of the breeding. Poor data in mode 2 farms could be explained in a lesser degree by the lack of isolation of males from females before the breeding season and an unfavourable sex ratio at the time of reproduction (1 ram for 55 to 70 ewes). This situation led to a fairly strong anoestrus in some ewes. Atti et al. (2004) revealed that the stimulation of ovarian activity in non-cyclic Barbarine females by the ram effect is very intense. Indeed, during the anoestrus season when LH is low, the ovaries are at rest (inactive), and ovulations are low due to the absence of pre-ovulatory follicles, thus causing a reduction or disappearance of heat. Therefore, the introduction of a male into a herd of females immediately restores this situation.

Many authors (Teresa et al., 2015; Cantalapiedra-Hijar et al., 2020) have reported that the productivity of ewes mated in autumn depends on both their age and weight, as productivity increases with weight. The lack of response of mode 2 ewes to the introduction of rams in autumn can only be explained by a particularly poor BCS of the females at this time.

Conversely, ewes mated in spring benefit from the nutritional conditions required to return to oestrus and be bred more quickly. This fact confirms the influence of breeding season on the zootechnical results obtained in Chlef and reported previously (Belhadia et al., 2020; Bensalem et al., 2009) in other environments. In agro-pastoral areas, such as Chlef, spring seems favourable for the breeding of Ouled Djellal sheep. Also, during this season, the quality of Ouled Djellal semen seems better (Taherti et al., 2023).

It is important to mention that autumn is therefore the traditional period for sheep lambing in the Chlef region. This framing of lambing, inconsistent with the grass growth cycle, seems *a priori* to constitute a factor in the balance of the forage system in this environment. It also seems *a priori* that the choice of this lambing period is much more strictly dependent on the type of production: production of lambs raised in sheepfolds, finished and sold quite heavy before the heatwaves and during major family celebrations such as marriages and circumcisions, in particular.

In addition, the divergence in data resulted from the fact that these two breeding groups adopted different feeding systems. Indeed, feed management on mode 2 farms is characterised by a predominance of grazed fodder units compared to distributed fodder units. Shrub and tree species (heather and rockrose scrub, cactus, cedar) made up the majority of herd grazing areas. On the contrary, the same areas in mode 1 farms are made up of fallows, meadows and cereal stubble

(herbaceous species), due to the importance of arable areas. Likewise, the level of supplementation on these farms was 0.8 to 1.2 kg of barley/ewe/day regardless of the type of resources grazed. On the other hand, on mode 2 farms, which aimed to save barley, ewes received on average only 0.30 kg/ewe/day during autumn and winter only. Therefore, the heterogeneity of the BCS of the ewes in the two breeding methods is linked to the difference in feeding management. When body reserves are not used, the ewes remain constantly in good condition (females of mode 1 farms). The absence of reserve mobilisation implies a good match between demand (physiological stage) and supply (pastoral resources and significant supplementation). On mode 2 farms, body reserves were heavily used, since the BCS of the ewes throughout the year was poor. Ewes giving birth in autumn intensively mobilised their body reserves throughout lactation, but did not replenish them sufficiently before the spring season. The low supplementation and rangeland grazing did not compensate for the decline in the ewes' body reserves. Given that BCS measures the importance of subcutaneous adipose tissue (Deniz Alic, 2016), changes in BCS therefore reflect variations in the state of body reserves. The benefit of the latter is known, particularly in breeding females. Indeed, Chemmam et al. (2003) noted a positive relationship between the body reserves of females during mating and the rates of ovulation, fertility and prolificacy. This justifies the mediocre performance results obtained in this breeding method during this season.

With different breeding practices (season and type of control and food system), Ouled Djellal sheep presented different fertility and productivity results, as also observed in the Aragonesa breed in Spain (Abecia et al., 2006), and similar to those obtained for the same breed in the El Tarf region, Algeria (Mebirouk et al., 2019).

This relationship was demonstrated in this study, by the strong correlation linking fertility and productivity to breeding method. For example, when the nutritional level was respected as in the case of mode 1, Ouled Djellal sheep were more productive through the production of a high number of sexual cycles. On the other hand, when it was kept in a restrictive regime, the number of cycles was greatly reduced and hence its productivity (Bodin et al., 1999).

These differences in yield are therefore the consequence of the behaviour and physiological reaction developed by the Ouled Djellal females under the influence of the mode of reproduction and feeding effects. Among the factors affecting productivity parameters, in addition to seasonality, diet appeared to be decisive, as previously described (Thimonier et al., 2000; Arbouche et al., 2013).

The genetic potential that the ewe will be able to express is the interaction between its genotype and the rearing conditions where diet plays a preponderant role (Landau and Molle 1997). Therefore, the variations observed in the reproduction parameters and productivity constitute the first explanatory elements of the characteristics of Ouled Djellal sheep with the diversity of reproductive mode and feeding system.

In this study, based on a very large database collected in natural breeding conditions, the productivity of Ouled Djellal sheep was weak to moderate. The variations observed during the year of work were strongly dependent on the breeding factors. The numerical productivity was well correlated with the following parameters: diet, nutritional state of the ewe at the time of breeding, the period and the

method of breeding. The best productivity results were obtained by females receiving a good diet, at BCS≥3 during the spring season, combined with the ram effect. The results of this study represent an important step towards the identification of non-genetic sources of variation that affect productivity of the sheep herd. This will certainly help to better understand the reproductive behaviour of the Ouled Djellal sheep in different regions and under several breeding systems. Therefore, this could be of great benefit to breeders in the selection of periods and breeding conditions.

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Utjecaj sezone parenja i stanja tijela na zootehničke parametre ouled djellal ovaca u polupustinjskim područjima

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Ključne riječi: *lokalne ovce, sustav uzgoja, učinkovitost, polupustinjska klima*