



Productive Performance of Ouled Djellal Ewes in Arid and Semi-arid Zones of Eastern Algeria

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Abstract: Reproduction contributes directly to farm profitability, and is summarized in economic indicators and performance analysis. The study was carried out on nine farms with a total of 762 breeding ewes of the Ouled Djellal breed (91 sedentary, 323 semi-sedentary and 348 transhumant). 165 ewes aged one year, 211 ewes aged two years, 290 ewes aged three years and 96 ewes aged between three to four years were used. With 578 ewes confirmed pregnant, 681 lamb births were recorded: 265 in the first group (winter), 280 in the second group (summer), 105 in the third group (summer), and 32 in the fourth group (autumn back-season), with 118 declared mortality losses, of which 36 lambs were stillborn. Twelve-month zootechnical data, such as age at first lambing, lambing interval, fertility rate, prolificacy or litter size, fertility rate and mortality losses were recorded from the raw database collected. Results showed that the average age at first lambing was 359.50 ± 21.13 days. The interval between two parturitions showed a reduction in time in relation to lambing rank (cyclic number of lambings) and ewe age. Average litter size was 1.06 ± 0.04 lambs for sedentary ewes, 1.17 ± 0.03 lambs for semi-transhumant ewes and 1.21 ± 0.05 lambs for transhumant ewes. Fertility and fecundity were 65% and 147.06% respectively. A mortality rate of 16.33% was recorded. Despite these differences between seasons, the origins of which are discussed, the reproductive performances analyzed were encouraging overall for improving the breed's profitability. With the exception of seasonal mortality, which showed a non-significant difference between autumn and spring, the results for the other performance parameters showed a highly significant difference.

Key words: Livestock system, birth, sheep, prolificacy, mortality, ewe.

Livestock farming is one of the most important sectors of agriculture. It is the main source of income for the populations of these regions (Slimani *et al.*, 2021). According to Rebai *et al.* (2023), sheep farming has retained its importance in

dietary habits and in the rural and territorial economy. In Algeria, sheep farming is the most widely practiced activity, with an estimated 28.3 million heads, 62% of which are females. Sheep numbers have improved despite the persistent problems of drought and mortality, which represent a considerable economic loss. Ewes play an important role in the country's agricultural sector, contributing to production performance (Baa *et al.*, 2020), but this wealth remains poorly exploited due to the archaic nature of these farms. The Ouled Djellal ewe is considered one of the leading breeds, with lambs born in autumn showing faster weight growth than those born in spring (Djellal *et al.*, 2015). It is known for its exceptional reproductive traits (high prolificacy, early puberty, long sexual season). Indeed, its litter size at birth varies from 1 to 3, with an average weight of 3.75 ± 0.73 kg (Dekhili, 2010). However, little is known about its performance, due to the lack of a research program. Factors influencing productive performance contribute strongly to profitability, such as weight, litter size, nutrition, weather conditions, and season. Knowing the growth curve and control capacity in the population studied can be an interesting aspect for breeders in the first stage of selection programs. Understanding the genetic architecture of the growth curve and its longitudinal data is an interesting biological scenario for simplifying the different stages of growth. The aim of this study is to evaluate productive performance and the influence of the external effect.

Materials and Methods

Data sources

The data were collected through field visits over 12 months from the central province of

Tébessa located at the extreme east of the Alghero-Tunisian border ($35^{\circ}24'15''$ N and $8^{\circ}07'27''$ E, 867 m), spread over 13.878 km². The climate of the location was semi-arid with rainy season from October to May. Average annual rainfall, of last 25-year period was 281.23 mm and temperatures ranged from -4 to 38°C.

Selection of sample

The sample for this study consisted of nine sheep flocks, spread over nine communes in the central province of Tébessa (Fig. 1), covering the entire study area in a homogeneous manner. The selected communes were part of the intervention zone and the central zone "C". The chosen zones chosen contained the largest number of breeders and so were deemed to be the most representative. The sampling followed concordance method for practical reasons of accessibility and the unavailability of a database. The sheep flock of the nine pastoral herds in the central zone totaled 762 ewes of the Ouled Djellal breed (Fig. 1). The variables studied were -age at first parturition (AFP), fertility rate (FR), litter size (LS), fecundity rate (FR), prolificacy (P), and lamb mortality rate (LMR).

Results and Discussion

Age at first lambing

The average age at first lambing was 326.50 ± 33.23 days (≤ 11 months). The variation was due to the rearing method used by the farmer. Extensive rearing favors repeated uncontrolled mountings. The average age at first lambing for ewes in fixed sedentary housing is 306 ± 53.21 days (10.2 months), 335 ± 21.38 days for semi-sedentary ewes, and 298 ± 27.12 days (9.9 months) for ewes in free-range housing. In free-range housing females are exposed

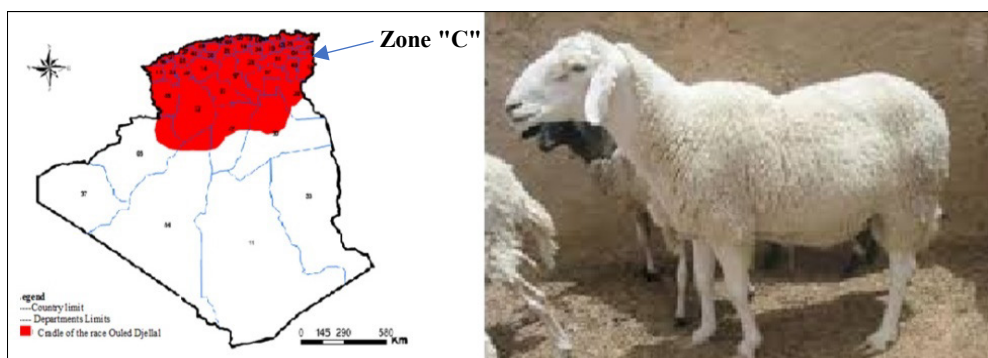


Fig. 1. Spatial distribution areas of Ouled Djellal breed in Algeria.

Table 1. Allocation of lambing according to size

Designation	Birth to lambs	Sheep lambled	Per cent
Single birth	496	496	85.81
Double birth	122	61	10.55
Triple birth	63	21	3.63
Total	681	578	100.00

to males, accelerating their development and sexual instinct, and entering estrus.

With different sheep breeding practices (season, type of control, and feeding system), Ouled Djellal ewes show different fertility and productivity results, almost all these animals in the study area feed on free-range natural steppe pastures (Halfa (*Stipa Tenessecima*), white and green wormwood (*Artemissia herba alba* and *Artemissia campestris*), certain grasses and woody species such as *Medicago arborea* alfalfa. Consequently, farmers had to extend the duration of his stay on these pastures that the animal can benefit as long as possible from the most of the plant cover. As a result, these extensive farming practices limit the planning of mating and reproduction, since free-stall breeding in the region is the main cause of mating spread throughout the year without any control of the technical course, which is the logical sequence of the reproductive physiological phases of Ouled Djellal self-pollinating ewes.

Registered births

Of the total number of ewes tested (762), only 745 were reproductively competent, i.e. a rate of 97.78% (98%). Under different breeding systems, Ouled Djellal ewes appear to display different reproductive behavior. Indeed, according to the results obtained, it appears that during the study year: high proportions of ewes only had their fertilizing matings in spring, conversely, ewes fought in spring benefit from the nutritional conditions required to return to estrus and be mated more quickly: this state of affairs confirms the influence of the fighting season on the zootechnical results obtained in the study region: 85% in single births, i.e. 496

lambs, 10.55 for double births (122 lambs) and 3.63% for triple births (63 lambs) (Table 1). The average production rate of Ouled Djellal ewes, influenced by the environmental aspect and the type of farming (sedentary, semi-transhumant, and transhumant), shows differences. These values were similar to those reported for the same breed of Ouled Djellal ewes by Boly *et al.* (1993). They were higher than the rates recorded for pasture-raised ewes, which varied on average from 85 to 92%, 77 to 95% and 82 to 87% respectively. Litter size at birth and weaning was 1.06 for sedentary ewes, 1.17 for semi-sedentary ewes, and 1.21 for transhumant ewes (Table 2).

Distribution of lambing by mode of birth

During the survey, single, double and triple births were recorded. Of the 578 ewes that gave birth during the period, 85.81% gave birth to a litter of a single lamb. This rate was higher ($p < 0.05$) than that obtained for double births (10.55%). Litters of three lambs represented 3.63% of the total. The frequencies of double and triple births in the present study were very low compared with those of single births (Table 1).). This variation in births of Ouled Djellal ewes is essentially linked to the feed intake of well-fed females, producing good-sized offspring for future generations of lambs. As a result, the management of these flocks needs to be ongoing, with the aim of reflecting performance traits, especially during the good seasons when feed and natural resources are in greater abundance.

Seasonal distribution of lambing

The variation in births observed reflects the level of management as well as certain environmental factors on pregnant ewes. The level of management is bound to vary according to the farm's management capacity, and control efficiency (feed and feed availability, litter, births, and mortality). Ewes selected and properly fed produce good offspring for future generations of lambs, so good management must be continuously followed

Table 2. Average zoo technical performance parameters by farm type

Model Breeding	Births	%Mortality	Prolificacy	Fertility	Fecundity
Sedentary	23.66±3.81	21.10±5.49	105.86±5.46	73.62±4.75	77.92±4.27
Semi-Transhumant	93.66±2.11	17.82±6.44	117.12±9.03	74.22±4.60	86.99±6.79
Transhumant	109.66±5.52	16.07±6.25	121.39±5.90	77.86±5.66	94.52±5.94
Mean	75.66±39.83	18.33±2.47	114.79±7.39	75.27±2.52	86.48±7.31

to reflect performance traits, especially during good seasons when feed and natural resources are in greater abundance. The staggering of births according to season, guided by the environmental environment, shows a decline in the number of births in dry periods during the summer when the percentage hardly exceeds 05%, and the winter season, when the concentration is very high (46.30%), due to the availability of good-quality forage, followed by the spring season (Fig. 2) (Azdinia *et al.*, 2021). The overall least-squares mean of recorded births was 65.71 ± 32.16 with the coefficient of variation 0.48%.

The effects of year according to roughness and season, the distribution of lambs according to the appropriate mode of management was 35.18 ± 12.42 , in sedentary 81.99 ± 25.71 in semi-transhumant and finally 90.93 ± 23.71 in transhumant, the means of distribution of lamb births, presents a highly significant difference a $p < 0.001$ between the sedentary breeders and the two categories of transhumant and semi-transhumant mode, influenced mainly by the mode of management, where the animal finds more well-being in one mode compared with the other, a fact justified by the two transhumant systems which come first and the semi-transhumant one ahead of the sedentary one where the animal is housed in a limited area under a high stocking density, On the other hand, both types of livestock management offer advantages in terms of freedom of movement, wide spacing, a wide variety of feed and an ambient climate where the animal finds the ideal environment for reproduction.

Litter size and offspring sired (Prolificity)

The Ouled Djellal ewe's offspring has an average value of 114.79 ± 7.39 heads. The variation of head number by rearing method

was about to six heads; ranged from 105.86 ± 5.46 for fixed rearing, 117.12 ± 9.03 for ewes on occasional movement, and 121.39 ± 5.90 for ewes on permanent movement. These figures show that transhumant rearing is in a good position to improve production performance (Table 2). The average litter size for ewes collected at first and second or more lambing was 1.18 ± 0.69 ; and 1.68 ± 0.65 , respectively. Litter size includes both live-born and dead animals. It shows an increase in litter size with ewe age and birth rank. This is probably due to widening of the pelvis with age. Berger and Ginisty (1980), put the figure at 108 to 115% for Djallonké ewes; Youssao *et al.*, (2008) reported an average litter size of 1.19 ± 0.81 lambs, while Ben Salem (2009) reported a rate of 1.32 ± 0.47 for Thibar black ewes. This interesting variation is associated to birth rank for each sheep breed. Ewes with the highest farrowing ranks gave birth to one lamb per litter. The higher the birthing rank, the higher the number of lambs per litter and becomes more important (multiparous ewes farrowing ranks 3 and above) produced an average of 1.76 lambs per litter. This variation in prolificacy is conditioned by intra and extra-animal factors, and these variations reported by various authors (Saadi (2016); Douh *et al.*, 2018; Rebai *et al.*, 2023) reveal that litter size ranges from 1.13; 1.12; 1.16 to 1.80 lambs.

They report that the average litter size increases from 1.05 to 1.35 from the first to 1.28 to 1.62 at the third lambing. As the Ouled Djellal is not known for being a prolific ewe (Benyounes *et al.*, 2013; Lamrani *et al.*, 2015), this difference in litter size from one region to another would probably be linked to the genetic type and rearing method that farmers adopt during the production cycle of their sheep flocks. Prolificity rates associated with autumn control were in line with those

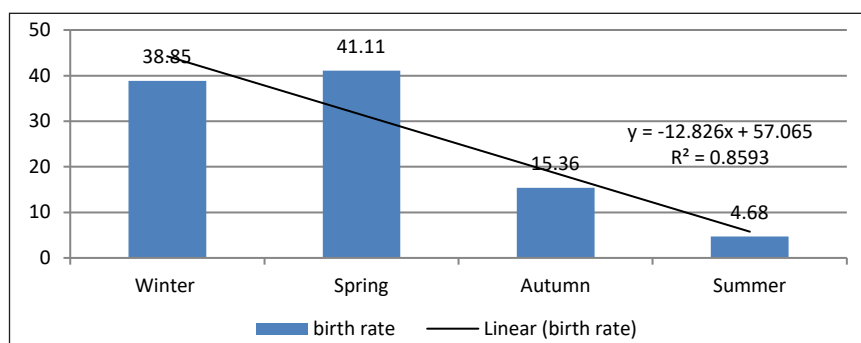


Fig. 2. Seasonal distributions of births in the Tebessa area Pl define "X" axis.

reported for Toronké ewes in Mali (Kouriba *et al.*, 2004) and Taâdmit ewes in Algeria (Lamrani *et al.*, 2013; Belhadia *et al.*, 2020). As shown by Scaramuzzi *et al.* (2006), the results can explain the relationship between a flock's prolificacy and its general condition prior to control, or the feed ratio was mainly based on poor rangelands.

Fertility

The fertility rate obtained during our study was 75.27 ± 2.52 . It was 74.22 ± 4.60 for ewes on occasional movement and 77.86 ± 5.66 for ewes on permanent movement. These figures show that transhumant farms are in a good position to improve their production performance (Table 2, Fig. 3). As this variable (fertility) has an exponential trend, it increases with female weight. They found variations between 84% and 90%. This observation is confirmed by Dekhili (2010), who noted that the effect of age, as well as the weight of the productive ewe, is very significant on fertility. He indicates a strong association ($p < 0.001$) between thoracic perimeter and ewe age. Bougouma-Yameogo *et al.* (2002) reported fertility rates below 90% for animals aged 3 to 4 years. The number of lambs born per ewe put to the fight improves with the age and weight of the ewe conditioned by the availability of food which conditions the type of farming adopted Sedentary, semi-sedentary, and Transhumant (Table 2), This hypothesis is confirmed by multiple studies of those of Youssao *et al.* (2008); Saadi (2016). Confirmed by Boudebza (2015) who found

that body condition score (BCS) varied significantly according to physiological stage and parity, and that ewes that had a double litter had significantly higher body condition. The average fertility performance (75.27 ± 2.52) observed in our study was low compared with 83% for the same breed in the Biskra region (Mefti Korteby *et al.*, 2017) and 44.8% for the Rembi ewe in the Tiaret region, Brahmi *et al.* (2011) reports an average fertility rate of 85.2% Barbarine bred under Tunisian conditions of the semi-arid production system.

Fertility rate

Fecundity is the ratio between the number of lambs born per mother and per year. It is very important to know, as it determines the flock's growth rate and profitability. During our study, we obtained an average rate of $86.48 \pm 7.31\%$. This is well below the rate reported by Boly *et al.* (1993), which is 108% for Djallonké ewes. It is; however, lower than the 154% reported by the same author for improved breeding. The difference in rates can probably be explained by feeding. No supplements were given to the animals during the experiment, and they were fed exclusively on natural pasture. These observations concur with those of Saadi (2016) of 63.09%, which reports the influence of feed type on the production of Ouled Djellal ewes. The results obtained for fecundity at the end of the spring struggle were consistent with those also reported for Ouled Djellal ewes in Algeria. Ouled Djellal ewes in Algeria by Dekhili (2010) in the Sétif region, Arbouche *et al.* (2013) in the

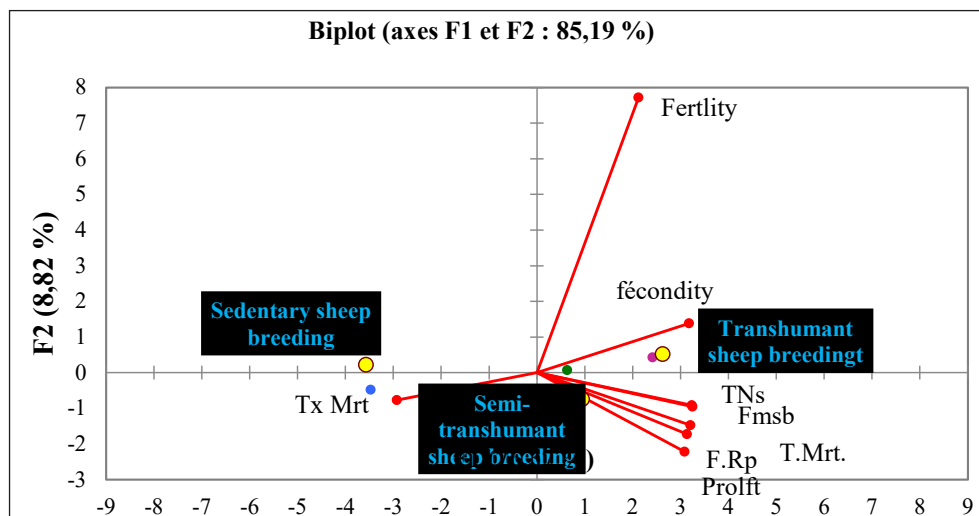


Fig. 3. Projection of variables in performance according to the rearing mode of Ouled Djellal ewes according to the appropriate sheep rearing system.

Table. 3. Analysis of differences between mortality rate modalities with a 95% CI

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Alpha (Modified)	Significant
Sedt lvs vs. Transht lvs	5.026	4.835	2.536	0.007	0.098	Yes
Sedt lvs vs. Sm.Transh lvs	3.284	3.160	2.447	0.020	0.050	Yes
Sm.Trnsht lvs vs Transht lvs	1.741	1.675	2.447	0.145	0.050	No

Sedt: Sedentary Livestock Transht: Transhumant Livestock; Sm.Trnsh: Semi-Transhumant Livestock

Bordj Bou Arreridj region, and Abaidia *et al.* (2020) in the Tébéssa region, and of 108% in the Souk-Ahras region in Algeria (Lamrani *et al.* 2013). However, they were very different from the 106% rate recorded in Sicilian-Sardinian dairy ewes in Tunisia.

Mortalities recorded in Ouled Djellal lambs

The number of lambs per litter largely determines the productivity of sheep flocks. Given the low heritability of production criteria, reducing lamb mortality between birth and weaning is undoubtedly one of the most attractive ways of improving productivity. Litter size, birth weight, and litter rank has an impact on postnatal mortality. The following losses were recorded during the experiment. Ewe mortality reached a figure of 118, with an average of 13.11 ± 6.254 cases of lost lambs, and an average rate of $18.33 \pm 2.4\%$. The majority of lamb deaths from birth to weaning occur in the first few days after birth and range from 5 to 30% (Dohu *et al.*, 2018). Most mortality cases were recorded in triple litters (females aged four years and over) and single litters (females aged 11 to 13 months). An average mortality rate of $18.33 \pm 2.47\%$ was obtained during our study. This rate ranged from 16.07 ± 6.25 for ewes on transhumance to $21.10 \pm 5.49\%$ for fixed ewes on sedentary farms (Table 2). These mortalities in multiple litters are probably due to the limited space available at grouping sites and the frequent nocturnal lambing schedule, which encourages trampling between individuals. Added to this is competition for udders within the litter. They could also be the result of the mother's inability to produce enough milk during periods of famine, or in the case of young mothers whose age does not allow them to produce enough milk because they are still growing.

Distribution of mortalities by rearing method

Lamb mortality data were calculated on all lambs born over a 12 month period, from birth to 120 days. The overall number of lambs lost

was 118, with an average of 13.11 ± 6.25 , giving an overall rate of $18.33 \pm 2.47\%$. These losses are due to a general weakness and debility could be attributed to the lower nutritional level of the diet, influenced by the environmental factor, as well as the type of management, it is higher, at 21.10 ± 5.49 , for the sedentary mode, 17.82 ± 6.44 for semi-transhumant lambs and 16.07 ± 6.25 for transhumant lambs, with a fairly clear geometric distribution (barycenter of 3.5667) on coordinates ($x=-4$, $y=0$), the coefficient of variation is 0.37; 0.44; 0.30 respectively. This significant difference between different management systems in the Tébéssa region has been approved by a differentiation of over 4%. The mortality rate is 24.75% with a coefficient of variation of 0.21, compared with 22.37 and 21.32 for semi-transhumant and transhumant livestock, with a coefficient of variation of 0.29 and 0.19 respectively (Dohu *et al.*, 2018). These mortality rate averages showed a non-significant difference ($p > 0.05$) between the Sedentary vs. Transhumant and Sedentary vs. Semi-Transhumant groups. This is due to the strong similarity of the two livestock types, whereas the Semi-Transhumant vs. Transhumant group showed no significant difference at de Pr > with degrees of 0.007, 0.020, and 0.145 successively (Table 3).

Conclusion

The results observed during the survey for farms residing at different tracks. Performance is variable and significantly different from one year to the next, showing that it is difficult to achieve reproductive performance on a regular basis. The differences observed between the three ewe breeding systems do not exceed 13%. On the other hand, the distribution of half-lambs shows that the supported farms lamb 60% of their lambs in autumn, which is the most favorable period in terms of climate and condition of the animals, with a high rate of losses. Mortality is a very worrying aspect, presenting a major obstacle to the development of this speculation, with its negative impact

on the economy, firstly on the income of the breeder himself, and secondly on the national scene, with enormous losses in terms of births recorded and accounted for by colossal financial envelopes. The Algerian Ouled Djellal sheep breed appears to be well adapted to its arid and semi-arid environment, with very good fertility when given a suitable diet, and easily able to support a breeding rhythm of one lambing every 8 months.

Acknowledgments

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Conflict of interest

All authors declare no conflict of interest in this study. Moreover, the corresponding author declares that this study is the original work containing unpublished material.

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