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Effect of Oestrus Synchronisation and Body Condition on Reproduction of Anoestrous Ouled Djellal Ewes

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Abstract: The objective of this study was to determine the effects of progestagen treatment administrated alone or coupled to an injection of eCG to synchronize oestrus on sheep reproductive traits during the anoestrus season under extensive management conditions of Algeria. Two flocks differing by level of body condition score were used. Fertility rates of treated groups, when compared to control groups, were higher for ewes mated at lean body condition (0.45-0.47 versus 0.10), whereas ewes mated at moderate body condition recorded higher performance during first estrus (0.37-0.45 versus 0.10) and comparable fertility rate for all mating period. Higher prolificacy rates were performed in synchronized groups of poor body condition (1.38 versus 1.00) when compared to control group. For moderate body condition flock, if progesterone and eCG treated ewes performed higher level of litter size than do control ewes (1.54 versus 1.20) for first estrus, prolificacy rate was similar between all groups for all mating period. Extra lambs weaned were significant for lean body condition synchronized groups (0.45) and for moderate body condition progestagen-gonadotropin treated group (0.33). Results indicated that it is possible to increase extra lambs weaned in anoestrous Ouled Djellal ewes after artificially induced oestrus.

Key words: Algeria, fertility, gonadotropin, progestagen, prolificacy, weaning rate

INTRODUCTION

Ouled Djellal (OD) is the predominant sheep breed in Algeria. Breeding season of OD breed extends from early April to the end of November, with greater concentration between June and August. Therefore, one of the major constraints to improve productivity is the weak level of fertility under field conditions during anoestrus season in early spring, which is the most suitable time for farmers to breed their flocks (Madani *et al.*, 2001). Starting season of mating out of season in early spring by synchronization of oestrus procure many advantages, such as reducing spread of mating, improving reproductive performances, accelerating lambing programs and producing lambs for winter markets. The response of the OD sheep breed to different synchronization treatments was not fully investigated.

In Mediterranean area, breeds have a short anoestrus during winter and early spring and within breeds, there is a large variation (Rosa and Bryant, 2003). Atti *et al.* (2004) have noted though in Barbary breed that as the effect of photoperiod on the seasonality of reproduction is limited, the traditional mating season occur during spring (April-May). However, for North African breeds Lahlou-Kassi (1986), noted that 40-60% of ewes have an anoestrous season from February to April. As this period corresponds to winter drought, feed availability is mostly reduced. Ewes mainly face seasonal food scarcity by body reserve use and probably limit or stop their breeding behavior and ovulation

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under extensive management. According to Bossis *et al.* (1999) negative energy balance before and during mating causes a linear decrease in the maximum diameter of successive dominant follicles and eventually results in anoestrus, due to suppressed LH pulse frequency in the final estrus cycle. According to Forcada and Abecia (2006), although during anoestrus season nutrition has a smaller influence on sexual activity than on ovulation rate, nutrition has an important influence on reproductive function, but the mechanisms by which these influences are mediated are complex and poorly understood.

Among alternatives for controlling reproductive activity in sheep, which efficacy had been confirmed over time, intravaginally inserted pessaries impregnated with progestagen utilized alone or associated to an eCG treatment (Kridli *et al.*, 2006) and used to stimulate and synchronize oestrus. This study was designed to determine the effect of progestagen administered alone or coupled to gonadotropin (eCG) treatment on reproductive performances (fertility and prolificacy) and weaning rate of adult OD ewes mated at lean or moderate Body Condition (BC) under extensive management system.

MATERIALS AND METHODS

Location and Animals

Experiments were conducted from January to December 2001 at two farms of semi arid region in Sétif Province, situated in North Eastern part of Algeria (36° 09' North, 05° 26' East). The studies used 310 OD multiparous ewes aged 3-5 years that were non-pregnant and non-lactating. Levels of body condition score (BCS, 0-5 scale) were selected to represent range of BC at early spring in semi arid highlands, which vary from 1.5-2.5 units. Ewes chosen for the experiment belonged to two large flocks (500 and 600 ewes), which had comparable body conditions; however ewes were selected to obtain two contrasting levels between the two samples. In farm A females (n = 148) were chosen to have a lean mean BCS (1.84±0.27 units), where ewes in farm B (n = 162) were chosen to have a moderate mean BCS (2.46±0.21). Ewes were scored at the insertion and the withdrawal of pessaries, at the end of mating and then every two months till the weaning. Both samples were managed to have positive energy balance from the insertion of sponges to the end of mating. Within each farm ewes were equally and randomly divided into three groups: control group (C), treated with progestagen (30 mg FGA-fluorogestone acetate; Synchro-Part®, Ceva Santé Animale, France) group (P) and treated with progestagen and injected, after sponge withdrawal, with 400 IU equine Chorionic Gonadotrophin (eCG; Synchro-Part®, Ceva Santé Animale, France) group (E).

Experimental Design

At mid March ewes of the P and E groups were synchronised in oestrus in both farms, pessaries were withdrawn 12 days later and then ewes of E group received subcutaneously an injection of 400 UI eCG. For mating ram-to-ewe ratio was minimized (1:10). Rams were isolated from the ewes and introduced simultaneously to the different groups after sponge removal. In order to have comparable positive body reserves dynamic, ewes chosen for the experiment were managed separately from day one of synchronisation to the end of mating period in both flocks, to be fed 300 g of barley grain and grazed resources of cereal fallows. Since, sponges insertion to the end of mating similar body condition dynamic was recorded between flocks. Ewes gained 0.46±0.15 units in flock A and 0.52±0.19 unit in flock B. After mating ewes were released to join to common flocks. Flocks utilised resources of cereal fallows during spring and cereal stubble during summer, had free access to water and mineral licks. Since, early autumn flocks received 300 g of barley grain, cereal straws and hay until subsequent spring.

Measurements

For estimating reproductive traits, two dependant variables were recorded. Fertility (ewes mated that lambed) and prolificacy (lambs born per ewe lambing) were estimated after lambing. Date of

conception in ewes returning to service was considered as the oestrus date nearest to 150 days before lambing. A ewe was considered to have been synchronised during the first fertile oestrus if it came in oestrus within five days of FGA sponges' removal (Spitzer and Carpenter, 1981). Reproductive traits were estimated as the proportion of ewes that conceived and lambled in either two consecutive oestrus cycles between 150 and 172 days following introduction of rams. Later births were considered unrelated to the effect of hormonal treatments and therefore, they were not evaluated. Lambs were kept with their dams until the weaning (two months of age) and had no access to feed other than that offered to dams. For evaluating productive traits two dependant variables were recorded; lambs survival as a trait of the ewe (lambs weaned per lambs born) and weaning rate (lambs weaned per ewe mated) were also recorded.

Statistical Analysis

Body condition score at mating was tested by using the pair wise t-test with a least square means statement. Least squares procedures were used to analyze data on ewe fertility, prolificacy, lambs survival and weaning rate traits. A fertility score of 1 or 0 was allocated to ewes that lambled or did not lamb. Prolificacy was the number of lambs born per ewe lambing (1 or 2), lambs survival was alive lambs at birth to weaning age (if alive: 1 and if died: 0) and weaning rate was the number of lambs weaned per ewe mated (0, 1, 2). Data are expressed as Mean±SE. Differences between experimental groups were analyzed by one-way Analysis of Variance (ANOVA). The significant controls of the differences between the groups were determined by Duncan's test.

RESULTS

Farm A

According to Table 1, fertility of ewes in treated groups was higher ($p < 0.05$) than that observed in control group during the first fertile estrus and for the all-mating period following ram introduction to ewes mated at lean BCS. Effect of synchronization on fertility rate was effective. Among 16 and 17 ewes that lambled respectively in P and E groups, 70 and 81% conceived during the first fertile oestrus. Prolificacy was greater ($p < 0.05$) in the P and E groups when compared to control group. Only single births were observed in the control group. Lambs survival rate was comparable for all groups. Consequently, productivity was more affected by fertility and prolificacy rates than by the percentage of lambs weaned. Both treated groups recorded a significant increase of weaning rate (lambs weaned per ewe mated) when compared to control group. Extra lambs weaned were 0.45 lambs per ewe mated.

Farm B

For the first fertile oestrus, moderate BCS groups receiving progestagen alone or coupled to an eCG injection achieved comparable fertility rate. However, control group performed significantly lower fertility rate than do treated groups. The overall lambing rate (from mating at first fertile oestrus) was

Table 1: Reproductive performances and weaning rate of synchronized and mated ewes at lean body condition

Variables	Treatments		
	Control	Progestagen	Progestagen+eCG
Ewes mated (No.)	50	49	47
Ewes lambled (No.)	5	23	21
Fertility (1st oestrus) (%)	0.02±0.02 ^a	0.33±0.07 ^b	0.36±0.07 ^b
Fertility (1st +second oestrus) (%)	0.10±0.04 ^a	0.47±0.07 ^b	0.45±0.07 ^b
Prolificacy (1st oestrus) (%)	1.00±0.00 ^a	1.45±0.14 ^b	1.38±0.13 ^b
Prolificacy (1st+second oestrus) (%)	1.00±0.00 ^a	1.30±0.11 ^b	1.38±0.12 ^b
Lambs weaned per lambs born (%)	0.80±0.20	0.87±0.06	0.86±0.05
Lambs weaned per ewe mated (No.)	0.08±0.04 ^a	0.53±0.10 ^b	0.53±0.12 ^b

^a and ^b: Means within a row with different superscripts differ ($p < 0.05$)

Table 2: Reproductive performances and weaning rate of synchronized and mated ewes at moderate body condition

Variables	Treatments		
	Control	Progestagen	Progestagen+eCG
Ewes mated (No.)	52	51	53
Ewes lambed (No.)	24	29	33
Fertility (1st oestrus) (%)	0.10±0.04 ^a	0.37±0.08 ^b	0.45±0.10 ^b
Fertility (1st +second oestrus) (%)	0.46±0.08	0.57±0.11	0.62±0.11
Prolificacy (1st oestrus) (%)	1.20±0.08 ^a	1.48±0.10 ^{ab}	1.54±0.11 ^b
Prolificacy (1st +second oestrus) (%)	1.33±0.09	1.38±0.09	1.55±0.10
Lambs weaned per lambs born (%)	0.94±0.07	0.90±0.09	0.94±0.07
Lambs weaned per ewe mated (No.)	0.58±0.09 ^a	0.71±0.10 ^{ab}	0.91±0.09 ^b

^{a,b} and ^c: Means within a row with different superscripts differ ($p < 0.05$)

19/29 (66%) and 24/33 (73%) for respectively P and E groups (Table 2). Fertility rates for the all-mating period were comparable for all groups. For the first fertile oestrus prolificacy rate was higher for synchronized ewes receiving eCG when compared to control group, where P group recorded a comparable performance to C and E groups. For the all mating period prolificacy rates were similar between all groups. Lambs survival rate was high and similar among all groups. Therefore, weaning rate was only affected by fertility and prolificacy. Group E performed higher weaning rate when compared to control group, extra lambs weaned were 0.33, while P group recorded a similar weaning rate when compared to earlier groups.

DISCUSSION

The present results show that during anoestrus season progestagen alone or associated to an injection of 400 IU of eCG after sponge withdrawal affected reproductive and productivity performances of OD ewes belonging to both lean and moderate body condition groups, although performances varied according to level of body condition at mating during the two consecutive oestrus cycles following ram introduction.

Fertility rates of synchronised groups for the all mating period (45-62%) were comparable to results described in earlier study for Awassi breed in Jordan (Alnimer *et al.*, 2005; Kridli *et al.*, 2006). However, fertility was less than those observed in Spain by Forcada *et al.* (1999) for Rasa aragoneza ewes (76.4-82.8%) and by Todini *et al.* (2007) for Sarda ewes (83%). Breed, dose, body condition and overall managerial conditions may have caused difference.

Level of fertility of synchronised ewes by intravaginal progesterone impregnated pessaries alone or coupled to gonadotropin administration were higher for ewes mated at lean BCS (0.45-0.47) than that observed in control group (0.1) and was in agreement with results reported by Kridli *et al.* (2006) for Awassi ewes. Ewes mated at moderate BCS recorded a higher fertility rate during the first fertile oestrus when compared to control group, but in the second oestrous period, this difference was not significant ($p < 0.05$). The lack of significance may be due the reduced reproductive seasonality, which is probably more modulated in this case by the effect of body condition at mating on the resumption of cyclic activity of non treated OD ewes.

Administration of progestagen alone or coupled to an eCG injection during the anoestrus season was effective in oestrus synchronization of OD ewes and confirms results reported by Kridli *et al.* (2006) for Awassi ewes. Using FGA-impregnated intravaginal sponges affected significantly the fertility of OD ewes mated at lean BCS during the all mating period and moderate BCS during the first fertile oestrus, while Laliotis *et al.* (1997) showed that synchronization during anoestrous period without gonadotropin (eCG) administration had been ineffective. Within flock, ewes yielded similar fertility rates regardless of treatment, indicating that FGA-impregnated sponges utilized alone or associated to gonadotropin treatment was likewise effective at inducing follicular development during

anoestrus, which is in agreement with results of Kridli *et al.* (2006). However, Zaiem *et al.* (1996) found that ewes receiving FGA and eCG had higher fertility rates (81.2-84.3%) when compared to FGA-treated ewes receiving no gonadotropin (57.5%). Discrepancy between the results obtained in the current study and those reported by the literature may be due to breed, time of eCG injection relative to sponge withdrawal, dose of eCG and routes of administration. According to Wildeus (2000), fertility vary greatly (27-83%) when intravaginal sponges are applied, dependent on breed, co-treatment, dose, management and mating system.

Nutrition is one of the main factors affecting ovulation rate (Forcada and Abecia, 2006). Fertility rates of moderate BCS groups were comparable (0.46-0.62), emphasizing that body condition at mating and treatment effects were likewise effective at inducing cyclic estrus. Fertility rate of control group of moderate BCS at mating (0.46) was close to performance of treated groups of lean BCS (0.45-0.47), confirming an efficient effect of body reserves at mating on reproduction performances. According to Forcada and Abecia (2006), high fat and food intake are able to modify the sensitivity of the hypothalamus to oestradiol negative feed back during seasonal anoestrus, with those effects being associated to a reduced amount of NPY mRNA and to an increase of plasma insulin, glucose and leptin concentrations.

Equine chorionic gonadotropin use in sheep estrus induction and synchronization programs is well established to improve follicular development, multiple births and conception rate (Cunningham *et al.*, 1980). For ewes mated at moderate or lean BCS, the mean litter size of E groups was similar to that of P groups, indicating no positive effect of eCG on prolificacy. These results agreed, with the findings of Kridli *et al.* (2006). For flock B prolificacy was comparable between all groups for all the mating period, although E group recorded higher level of prolificacy for the first fertile oestrus when compared to C group. Probably eCG effect on prolificacy was more effective during only the first oestrus. For ewes mated at lean BCS, P and E groups yielded similar litter size, which was significantly higher than that of control group and contrast with the findings of Kridli *et al.* (2006). Difference between flocks indicated that progestagen treatment alone or coupled to eCG increased significantly litter size of only lean BCS ewes at mating. Probably interactions exist between body condition, body condition gain at mating and effects of eCG on ovulation rate and liter size for OD breed. According to Forcada and Abecia (2006) during anoestrous season nutrition is one of the main factors affecting reproduction and has more influence on ovulation rate than on sexual activity.

Synchronization improved the production of OD ewes mated during anoestrus season. However, results are different when either type of treatment or BCS at mating are considered. Synchronization improved significantly reproductive efficiency, although extra lambs weaned varied from 0.13-0.45 per ewe treated. Improvement is similar to that previously reported for Spanish Rasa Aragonesa breed treated with Melatonin on March (Forcada *et al.*, 2002). For lean BCS ewes, extra lambs weaned per ewe mated were higher for synchronized groups (0.45) than control group. For moderate BCS flock, significant more lambs per litter (0.33) were recorded in E group when compared to non-treated group, while P and C groups recorded a comparable performance. For flock A and E group of flock B differences can be associated with a significant increase in fertility and prolificacy. Superiority of FGA-eCG ewes mated at moderate BCS may be due to the combination of better nutritional condition at mating and eCG effect on litter size. Within flock, differences between treated and control groups for respectively fertility (0.35-0.37) and extra lambs weaned per ewe mated (0.45) were more pronounced in treated groups with low BCS when compared to equivalent groups mated at moderate BCS (fertility: 0.11-0.16; extra lambs weaned: 0.13-0.33). Although dynamic of body condition during mating was quite similar, these results suggest that there were different responses of reproduction to level of BC at mating. Fertility and productivity rates of treated groups were the highest for moderate BC at mating, while effect of flushing on reproduction in treated groups of lean BCS was the most

efficient. According to Bocquier *et al.* (1993) in a study with Prealpes ewes, the effect of body condition gain was stronger than the effect of BC (static), but both were confounded in a static-dynamic effect.

These data demonstrated that both BC and synchronisation could have an important influence on the response of anoestrus OD ewes to out-of-season breeding with hormones in extensive management systems of semi arid region of Algeria. Synchronization of ewes can be successfully applied to improve productivity. The combination of nutrition management to controlled breeding techniques, such as oestrus synchronization, would benefit an intensive breeding program of OD breed.

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