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Female response to ram effect in the Barbarine breed: Phenotypic and genetic parameter estimation

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ABSTRACT

The "ram effect" has been an alternative method among many techniques to control the period of sexual activity in sheep. The objectives of this study were to (1) study the reproductive performances of the Barbarine breed in the spring, (2) to evaluate females' response to the ram effect, and estimate the phenotypic and genetic parameters of the females' response to the "ram effect". A total of 16,150 matings of 4201 ewes recorded during a period of ten years in seven flocks was used in this study. Among these ewes 1335 have known parents and were born from 199 sires and 1053 dams. Four cyclicity traits were analyzed: spontaneous, normal, short and not answer to the ram effect. The main results show that approximately 30% of the females were cyclic out of season and more than 60% became cyclic with the "ram effect". Flock, year and age at lambing had significant effects on the traits analyzed. A high negative phenotypic correlation of −0.75 was found between responses of normal cycles and responses of short cycle. The spontaneous ovarian activity in the spring was negatively correlated with the absence of response to a ram effect ($r_g = -0.44$) and positively correlated to the response by a normal cycle ($r_g = 0.63$). The correlation between responses with the normal cycle and short cycle was highly negative ($r_g = -0.88$). For all variables, heritability was low (from 0.03 to 0.09) but significantly different from 0 and repeatability was slightly higher and varied from 0.06 to 0.1. These results indicate the great opportunity offered by the Barbarine breed for out of season breeding.

1. Introduction

Reproduction is seasonal in sheep which allows defining a period of sexual activity and a period of sexual rest or anoestrus. The sexual season occurs when ewes display spontaneous and cyclic ovulatory activity. It starts when the duration of daylight decreases and lasts until it begins to increase, which corresponds to the period from August to February in the northern hemisphere (Thimonier and Mauléon, 1969) and from February to July in the southern hemisphere (Ortavant et al., 1985). However, in temperate latitudes, large differences of sexual activities were observed between sheep breeds. Breeds originated from northern Europe, where yearly variation of the length of day and night is important, presenting a shorter sexual season than those originating from southern countries. This corresponds to the adaptation of the breeds to their environment (Bodin et al., 1999), and this difference between breeds reflects a genetic variability that also exists within breeds (Chanvallon et al., 2009; Maton et al., 2010).

Different techniques based on hormonal treatments, associated or not with photoperiodism treatment can be used to control the period of sexual activity and the moment of reproduction in a flock. Although widely used in many countries, these methods remain penalized by their costs and their requirement of technical qualifications. An

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alternative method is to exploit the so-called "ram effect". It consists in joining active rams and sexual inactive ewes after a separation of nearly two months (Khaldi, 1984; Thimonier et al., 2000; Delgadillo et al., 2009; Raes, 2010). Following the introduction of the rams, a large percent of the females ovulate within 2–4 days. This ovulation is silent (without oestrus) and not fertile, but may trigger a sexual activity period. Thus, it is followed about 17 days later by a second fertile ovulation associated with oestrus behavior. However, with variable frequency, the first ovulation is followed by another silent ovulation that occurs about 6 days later (short sexual cycle) which in turn is followed by a normal sexual cycle (Ungerfeld et al., 2004; Chemineau et al., 2006; Raes, 2010).

In spite of its large genetic diversity, the sheep livestock in Tunisia remains predominated by animals with low productivity. This induces serious constraints for the improvement of farmer income since sheep economic efficiency mainly depends on female reproductive performances. The Barbarine fat tail sheep breed represents 60% of the total sheep population in Tunisia and is encountered all over the country. Due to Mediterranean rainfall conditions, the traditional period of mating occurs in the spring, at the beginning of the sexual season (Khaldi, 1989). The fat tail of Barbarine sheep presents large size and shape variability, being a natural barrier for the ram during mating which requires the assistance of the shepherd. Therefore during the mating period, each day the shepherd achieves the oestrus detection of ewes in its flock and gives aid for mating which can be easily recorded. This particular specificity is very interesting to control the onset of oestrus and to study reproductive events such as the response to a ram effect and fertility. Since the physiological mechanisms involved in the ram effect are not specific, the results observed in this breed can be extended to other breeds having similar sexual seasonality. This study was set up to study the reproductive performances of the Barbarine breed in the spring, in order to describe and to analyze the response of the females to the male effect, and to estimate the phenotypic and genetic parameters of components of this response.

2. Materials and methods

2.1. Animals

Data came from a total of 16,150 matings of 4201 ewes of the fat tail Barbarine breed collected over a ten year (1993–2002) period on two state farms (Table 1) in which ewes are spread among seven flocks of about 230 ewes for management practices when grazing as well as during mating and lambing. In these flocks, mating takes place in the spring. After a total separation of at least one month, rams (about 1 ram per 25 ewes) are reintroduced in the flocks according to the year's climatic conditions from 20 April to 13 May (Table 1). Due to the ewe fat tail, mating requires external input. Therefore during the mating period, the shepherd performs oestrus detection two times per day with a ram, gives aid for the mating and records the date and the animals involved. Moreover, to totally avoid non controlled matings, rams are separated from the females during the night. This mating period lasts about 3 months. The breeding rams come from other flocks belonging to the same farm or from other farms related to the "Office de l'Elevage et des Pâturages (OEP)" which is a governmental livestock organization. Recorded data for each mating included the following: the beginning of the mating period (joining), the ram and ewe identification, and for each lambing, ewe identification, lambing date and the corresponding litter size. Ancestry is only known for replacement females born during the recorded period. Consequently only 1335 females have known parents and are born from 1053 dams and 199 sires. These sires are spread among the 7 farms and 50% and 23% of them have progeny in at least 2 and 3 flocks respectively. The average progeny number per sire is 6.4. Flocks are raised on a low input grazing system where average rainfall is 330 mm/year. In addition to grazing, the animals received a complementation of hay and concentrates which are used as supplement during breeding, late gestation and beginning of suckling periods. The quantities distributed varied from 0.5 to 1 kg/head/day for the hay and 200 to 300 g/head/day for the concentrated feed.

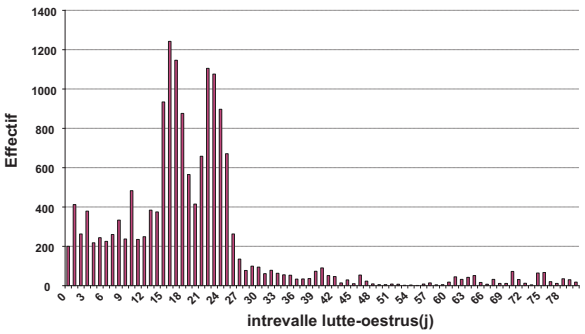

Fig. 1. Oestrus distribution after joining rams and females.

2.2. Methods

As expected, the distribution of oestrus follows a bimodal distribution, with a first mode 16 days after the introduction of the rams (d16) and a second mode 6 days there after (d22) (Fig. 1). This oestrus distribution allows defining 4 variables of cyclicity for each ewe and for each year.

2.2.1. The spontaneous cyclicity (cyspon)

This variable points out the seasonal status of a ewe at the beginning of the mating period before the introduction of the ram in the flock. This variable was coded 1 (0 otherwise) for the females already cyclic at this time and which presented an oestrus between the 1st (d1) and 17th day (d17) of the introduction of the male. To avoid confounding with ewes responding to the ram effect, we limited the interval of time between d0 and d14. This may slightly underestimate this variable.

The three following variables point out the status of the females which were non cyclic at joining. Consequently their value was missing when cyspon was coded 1.

2.2.2. Ram effect response with normal cycle (cynor)

This variable was coded 1 for the ewes which displayed an oestrus between d15 and d19 (0 for the other ones). It is assumed that these ewes had their sexual activity triggered by the male effect and presented a normal cycle after the first silent ovulation. This group also included the few ewes which were already cyclic at the joining but did not get pregnant and returned to oestrus between d15 and d19.

2.2.3. Ram effect response with short cycle (cysho)

This variable was coded 1 for the ewes which displayed an oestrus between d20 and d28 (0 for the other ones). They were supposed to have their sexual activity triggered by the male effect but presented a short cycle after the first silent ovulation.

2.2.4. The females that do not answer to the ram effect (cylate)

This variable deals with ewes that did not respond to the ram effect but they came into oestrus at least 29 days after the introduction of the ram. These are the females that have a belated oestral cycle, reproduction problems or for which a previous oestrus was not detected. For those ewes, this variable is coded 1 (0 otherwise).

These four variables are exclusive; it means that for a given year, a female is coded 1 only for one variable (0 or missing for the others).

All ewes were weighed within 10 days before the beginning of mating. That allowed defining three groups of live weights before mating: lower than 41 kg, between 41 and 46 kg, and higher than 46 kg.