

# AG-REML ESTIMATION OF GENETIC PARAMETERS FOR TOTAL MILK YIELD IN SICILO-SARDE SHEEP

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## ABSTRACT

Genetic parameters were estimated for total milk yield of a Sicilo-Sarde flock (INRAT (Tunisian National Institute of Agronomic Research) Experiment Station, Béja) for 881 lactations. Total milk yields were calculated from 8220 bimonthly test day records using the Fleischmann method. Animals included in the relationship matrix were 363 ewes and 83 rams. Estimates were from the use of univariate, analytical gradients, restricted maximum likelihood procedures (VCE package). Least squares analyses showed significant effects of year-season, age of ewe, and lambing type on milk yield, with the year-season being the most important factor. Genetic estimates agreed closely with those obtained previously in this population and were lower than those obtained in other dairy sheep populations. Heritability and proportion of permanent environmental variance were  $0.14 \pm 0.06$  and  $0.19 \pm 0.06$  respectively. Genetic and phenotypic variation coefficients reached 7.6% and 23.4% respectively. Our results indicated that efforts should focus on improving the level of management and starting an adequate selection programme, in order to improve milk yield and to repair decreases in milk production level observed in the actual conditions of Sicilo-Sarde breed.

**Key words:** Sicilo-Sarde, univariate animal model, genetic parameters, milk yield

## INTRODUCTION

Milk from sheep is a product that is high in useful materials which explains its transformation only into cheese. Cheese yield from ewes' milk duplicates that obtained from cows' or goats' milk (Assenat, 1985). Interest in research into the yield and composition of milk from small ruminants in general has also increased in recent decades because of the growing intensification of sheep and goat production systems (Gonzalo et al., 1994; Haenlein, 1993) and the initiation of breeding programmes (Gabiña and Barillet, 1991). In this way, Sicilo-Sarde breed, main dairy sheep breed in Tunisia, is still without a consolidated selection programme although some efforts are actually going into starting a reasoned programme. A little but gradual decrease of milk production has been observed the last years in Sicilo-Sarde breed and the sheep dairy industry in Tunisia is still in its infancy. However due to the good quality and the high food value of the end products there is considerable potential for adding value to existing sheep operations. This study aims at estimation of genetic parameters for total milk yield in Sicilo-Sarde ewes, important tools as to the selection programme starting.

## MATERIALS AND METHODS

**Data.** Data were collected on a dairy experiment farm of the National Agronomic Research

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Institute of Tunisia (INRAT). A total of 881 lactation records were obtained, between 1997 and 2002, from 303 Sicilo-Sarde ewes. The flock was on the A2 plan of testing (every two weeks) and all ewes were milked twice a day. According to the testing programme applied for Tunisian dairy ewes, milk yield is defined by the production at the milking period only, after two months of suckling. The first test day record was obtained at least 3 d following weaning. Subsequent records were obtained at approximately two-week intervals thereafter. Milk yield per lactation were estimated and adjusted to 180 d (L180) using the Fleischmann method. From the INRAT experiment station data file other available pertinent information included date of milk sampling, number of suckled lambs, date of birth of ewe and lambing date.

The mean number of test day records per lactation was 9.3 and mean lactation records per ewe were 2.9. Animals included in the relationship matrix were 363 ewes and 83 rams. Some ewes having their own data were also listed as dams of ewes.

**Statistical analysis.** Data were gathered according to the different levels of the main environmental variables that were thought to affect milk yield. There were four lambing age groups, two types of lambing (single or multiple), and 12 levels of year-season.

All known relationships among individuals were considered in the model of analysis that included the previous fixed effects. Data were analysed with the following univariate repeatability animal model:

$$Y_{ijklm} = \mu + YS_i + LG_j + BT_k + A_l + PE_l + e_{ijklm}$$

Where

- $Y_{ijklm}$  = dependent variable;
- $\mu$  = population mean;
- $YS_i$  = fixed effect of year-season  $i$ ;
- $LG_j$  = fixed effect of lambing age  $j$ ;
- $BT_k$  = fixed effect of birth type  $k$ ;
- $A_l$  = additive genetic random effect of the individual  $l$ ;
- $PE_l$  = permanent environmental random effect on the individual  $l$ ; and
- $e_{ijklm}$  = random residual.

Genetic parameters were estimated by the AG-REML (Restricted Maximum Likelihood Estimation on the basis of Analytical Gradients) procedure (Neumaier and Groeneveld, 1998) using the VCE package (Groeneveld, 1998). Environmental effects were estimated using a fixed model including the same environmental fixed effects appearing in the above mixed model. Data were thus analysed by the GLM procedure using the Statistic Analysis System programme, SAS package.

## RESULTS AND DISCUSSION

The total milk yield reached 116 kg with an important phenotypic variability (21.9%). Results were in agreement with recent values reported for the same breed (Gadir, 1998; Toukabri, 1998) and fell into the range of estimates that have been recorded for other dairy sheep in Mediterranean countries (Barillet and Boichard, 1987; Gabiña et al., 1993; El-Saied et al., 1999; Othmane et al. 2002). However, differences imputable to breed are often difficult to evaluate because they are usually associated to different managements, environmental conditions and/or feeding practices specific to each breed. In this way, the longer milking period in Sicilo-Sarde breed may make up for its slightly lower production

potential.

Year-season (YS), age of the ewe at lambing and lambing type contributed significantly ( $P < 0.001$ ) to the variations in milk yield. The YS factor became the major variation factor. It accounted for 24% of the phenotypic variance in total milk yield. The youngest ewes produced the least amount of milk. As the ewes became older there was an increase in milk yield. Ewes that gave birth to multiple lambs had a higher milk yield than ewes that gave birth to singletons. The physiological explanation of this fact is that a high number of lambs corresponds to a greater placenta area which results in higher mammary hormone level and a more developed udder (Delouis, 1981).

Table I presents the heritability, permanent environmental variance proportion, and repeatability for total milk yield. Heritability and repeatability estimated from this study reached 0.14 and 0.33, respectively, with a genetic variation coefficient of 7.6%. There were no previous genetic studies on the genetic parameters for lactation mean of milk yield in Sicilo-Sarde breed. However, we know of only one previous genetic study for milk yield in the same breed using a test day animal model. This study, involving both heritability and repeatability (Othmane, 2004), gave estimates similar to ours. However, our results tend to be lower than others for certain foreign breeds raised under different management conditions. There are, of course, many possible reasons for this trend. Among them is the enormous diversity in management practices that characterise the entire population (mainly low genetic connection), low production level which is consequently projected to decline slowly but progressively, and the lack or infancy of a selection programme and their associated consequences. Implementation of an efficient programme over a long period of time, fulfilment of nutritional needs and diet formulation, and careful attention to milking management for sheep breeds, such as the Sarde and Lacaune, should not be forgotten, although in the latter case only first lactation records were usually used. In this way, Othmane (2004) reported that heritability of milk yield decreases markedly in multiparous Sicilo-Sarde ewes. Available information on dairy cows indicates also that heritability estimates increase with a higher production level (Van Vleck et al., 1988) and decrease with more lactations (Berger et al., 1981). We consider that our results were probably influenced by the enormous variability in conditions of milking practice and management in general (hand milking, nutrition, etc.) for the entire population.

Table I. Heritability ( $h^2$ ), proportion of permanent environmental variance ( $c^2$ ), their standard error (SE), and repeatability (r) for total milk yield.

| Trait                       | $h^2$ | SE   | $c^2$ | SE   | R    |
|-----------------------------|-------|------|-------|------|------|
| Total milk yield (L180), kg | 0.14  | 0.06 | 0.19  | 0.06 | 0.33 |

In any case, this study was a first attempt and it is useful to have more information about genetic parameters for this trait in the entire population and its relationship with the main milk components, the Sicilo-Sarde milk being exclusively transformed into cheese. From a genetic point of view, our results showed acceptable but low values, testifying to the need to have an adequate selection programme structured on the entire population scale according to its actual conditions. Otherwise, milk production level in Sicilo-Sarde breed is projected to still declining progressively. Breeders must bear in mind that some management practices have to be changed, which is often helpful to think through a reasonable selection schema implementation using adequate methods.

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