NUCLEUS-BASED PROGRAM TO IMPROVE MILK PRODUCTION IN COMISANA SHEEP IN SICILY

F. Pinelli[1], P.A. Oltenacu[2], G. Iannolino[1], M. Scimonelli[1], G. Romeo[1], A. D'Amico[1], J. Carvalheira[3], A. Carlucci[4] and A. Vella[1]

[1]Istituto Sperimentale Zootecnico per la Sicilia, Palermo, Italy
[2]Department of Animal Science, Cornell University, Ithaca, NY, USA
[3]ICBAS, Universidade do Porto, Portugal
[4]Associazione Provinciale Allevatori di Matera, Italy

INTRODUCTION

The Comisana is one of the most important breeds of Mediterranean dairy sheep, mostly raised in Central and Southern Italy (Figure 1). The importance of the breed is due to its capacity to produce milk for cheese production in the extreme environmental conditions of the Mediterranean. More than half of the entire breed population is raised in Sicily, where the Comisana sheep represents a precious genetic and economic resource for the marginal areas of the island. Improving Comisana, as well as other local dairy sheep, is a key component of a program aimed at ensuring the economic development of agriculture in these areas based on optimum utilization of local resources.



Figure 1. Sheep of Comisana breed

At the present time, the genetic progress in the population of Comisana sheep is probably close to zero, and the within flock selection which is occurring is not effective. On the other hand, the implementation of a genetic program to improve Comisana sheep is severely constrained by a number of environmental and structural factors. The critical ones include:

- poor animal identification;
- use of multiple rams in flocks;
- lack of population structures to facilitate the gene flow;
- unreliability of official records collected in the field.

To genetically improve the dairy traits for the entire population of Comisana sheep in Sicily, the Istituto Sperimentale Zootecnico has implemented a flock-nucleus breeding program that involves a group of commercial dairy sheep farms, and aims to overcome the major limitations that currently prevent the Comisana breed from effective genetic improvement. The objective

of the breeding program is to produce breeding rams to be used to disseminate the genetic progress achieved in the nucleus to the rest of the farms, within the framework of a pyramidal management of the breed population.

STRUCTURE OF THE BREEDING PROGRAM

The breeding program utilizes a strategy based on structuring the regional population in a genetic pyramid. A selection nucleus of 3000 ewes in 7 flocks represents the apex of the pyramid, where the genetic gain is generated. Participating farms in the first stratum of the pyramid are utilized to disseminate the genetic gain to the rest of the population. The progeny test stage takes place in all flocks of the nucleus. The flock located at the Istituto Sperimentale Zootecnico performs the function of multiplication: elite mating of the 100 best ewes with the top 2 proven rams is used to produce 40 young rams for progeny testing each year. The top 6 proven rams mate with the remaining ewes to produce the replacement ewes for the multiplication flock and the breeding rams for disseminating genetic progress through the rest of the population.

IMPLEMENTING THE BREEDING PROGRAM

Animal identification and milk recording. A precondition for developing a genetic improvement program is high accuracy of data collected in the field. For the Comisana nucleus flocks, a specific on-farm identification and production recording system has been developed. Records are collected and stored using Progecom, a software package that consists of a data base management program, an electronic animal identification system and a field interface program that interrogates the animal identification system and facilitates the collection of records on the farm, and their transfer to the data base management program. This system greatly simplifies and improves the accuracy of the control of production activity. A standard A_4 testing program (monthly recording for the two daily milkings) was started in the nucleus flocks in 1998-1999 production season.

Progeny test program. Given a testing capacity of 400 daughters in the nucleus, the progeny test program aims to compare, every year, the genetic merit of 40 young rams across flocks, with about 10 daughters per ram (Pinelli *et al.*, 2000). Short of using AI, genetic ties between flocks were created by assigning a limited number of rams to have daughters in two flocks.
After progeny test breeding, the young rams are moved to the Ram Center at the Istituto Sperimentale Zootecnico, and are held until their daughters complete first lactation and their breeding values are estimated.

Genetic evaluation of animals. An autoregressive test day animal model (TDAM) developed by J. Carvalheira *et al.* (1998) is being used for the genetic evaluation of the animals in the nucleus. The computer software is based on a series of programs that build the incidence matrices according to the structure of the data, and compute the inverse of the genetic additive relationship matrices to be incorporated into the coefficient matrix of the BLUP mixed model equations.

Multiplication stage. The multiplication stage of the genetic program will be started in the spring 2002 breeding season, based on the genetic evaluation of the rams that were progeny

tested in 1999. It is planned that the first batch of breeding rams for dissemination will be available in spring 2003 and be used in the first stratum of flocks enrolled in the National Production Recording program that also have good animal identification systems, adequate management, and with at least 50% of their animals registered in the Breed Book. With these requirements, these flocks should be able to produce breeding rams, which are expected to be sold for use in the third stratum of the pyramid, - meaning to all other commercial flocks in Sicily.

Educational and promotional program. In order to support the implementation of the breeding program in the field, a number of educational and promotional activities are being developed. Periodic meetings organized with Associazione Regionale Allevatori-Sicilia aim to educate farmers about program objectives and gain their willingness to participate in it. Educational and promotional tools already developed include posters, deplaints, video-clips and a CD-ROM also available on the web (www.comisana.it). The CD-ROM provides information on the dairy sheep production system in Sicily, the history and characteristics of the Comisana breed, and the requirements needed to register animals in the Breed Book. An entire section is devoted to outlining the major components of the flock-nucleus breeding program and the benefits that farmers can obtain through their participation. These educational materials help to communicate the purpose of the genetic breeding program at a variety of cultural and technical levels, and are critically important for the ultimate success of the breeding program.

RESULTS AND DISCUSSION.

The first cycle of progeny testing was carried out in a single flock in 1996 – 1998, with 30 rams being ultimately evaluated. The best 4 rams were used to cover the best 60 ewes (elite mating) and produced the second batch of young rams. In January 1999, the nucleus was expanded to include 6 new commercial flocks. A new group of young rams started the progeny testing cycle in spring 1999. Analysis of the data collected from the start of the project since June 2001 is presented in this paper**.** The data consisted of 4745 animals of which 2125 had production records for a total of 17559 test day records.

The variance components and the genetic parameters were estimated and were used as inputs for subsequent genetic evaluation analysis to determine the genetic ranking of all individuals in the data set. The genetic variance was small relative to phenotypic variance, resulting in heritability values between 0.20 and 0.22 for the three parities considered. The estimated short-term environmental variance was relatively large indicating that an important part of the non-genetic variation due to the repeated effect of ewe within lactation was accounted for by this effect. The test day records were highly correlated within lactation, with short-term environmental autocorrelation of 0.75, 0.80 and 0.72 for first, second, and third or greater lactation, respectively. Long-term environmental effects had a negligible impact on milking performance with long-term environmental autocorrelation of essentially zero.

In the second stage of the analysis the breeding values (EBV) and accuracy of EBV were estimated for all animals in the data set. Using BLUP methodology, these estimates are pre adjusted for all other effects included in the model. The EBV milk yield per day for all 4745

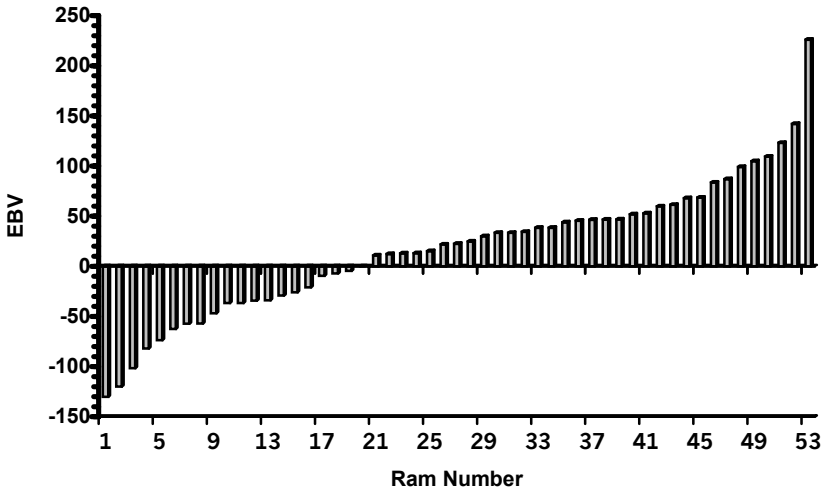


Figure 2. Distribution of EBV for 53 rams born in 1998

animals in the analysis had a mean of 3.8 g and minimum and maximum EBV values were –301 and + 547 for a total range of 848 g. When only the 390 sires in the data set were considered, the mean EBV was 0.6 g. and minimum and maximum EBV values were –212 and + 226 for total range of 438 g. These results indicate that good opportunity exists for selection and, therefore, for genetic progress. In Figure 2, the distribution of EBV for all rams born in 1998 and progeny tested in 1999 is presented.

CONCLUSIONS

A breeding program to improve milk production in Comisana breed was successfully implemented since 1996 by the Istituto Sperimentale Zootecnico per la Sicilia. The program was designed to overcome the major limitations faced by dairy sheep improvement programs: poor animal identification, limited and unreliable control of production, use of multiple rams in flocks and lack of a genetic structure in the flock population. The opportunity for genetic progress for Comisana breed is great, with a range in genetic potential for milk of more than 800 g of milk per day. The best 4 rams identified trough progeny test had an average genetic merit of about 200 g of milk per day. The program has moved to multiplication phase and the first batch of breeding rams for dissemination is expected to be available in spring 2003.

REFERENCES

Pinelli F. *et al*. (2000) *Proc. 6th G. L. Dairy Sheep Symposium* : 129-142.
Carvalheira J. *et al*. (1998) *J. Dairy Sci*., **81**: 2738-2751.