USE OF THE EQUIVALENT MATURE EWE FOR THE GENETIC EVALUATION OF SARDA DAIRY SHEEP

A. Carta, S.R. Sanna, S. Casu

Istituto Zootecnico e Caseario per la Sardegna, Reg. Bonassai, 07040 Olmedo, Italia

SUMMARY
This paper presents a comparison between two genetic evaluations of Sarda dairy sheep breed based upon milk yield corrected for milking length (CMY) and milk yield further on preadjusted for the age class-parity-lambing month interaction (EME). The animal model indexations included 756,522 lactations of rank from 1 to 4. Genetic parameters were estimated with a sire model on a data subset including 127,393 lactations performed from ewes born up to '92. The contemporary grouping (CG) strategies used for the analysis of the two variables were different. In the model for CMY, the CG were defined by the interaction flock-year-age class. In the model for EME, three CG were identified within flock-year: the yearlings, the mature ewes with lambings before the 15th December and the mature ewes with lambings after the 15th December. The interaction age class-parity-lambing month within year of production was included as a second fixed effect in both the models for CMY and EME. EME showed higher values than CMY of additive genetic variance (402 l^2 *Vs* 357 l^2), h^2 (0.29 *Vs* 0.26) and repeatability (0.40 *Vs* 0.38). The grouping strategy used for the EME analysis also increased the number of compared sires per adult ewe CG. The Spearman correlation coefficient between EBV showed that the EME evaluation modified the rank of the females (r=0.95) and mainly of the natural mating sires (r=0.91), while the AI sires were equally ranked (r=0.99).
Keywords: dairy sheep, Equivalent Mature Ewe, heritability, contemporary groups

INTRODUCTION

Over the last ten years genetic evaluations based on animal model applied to lactation yields have been realized for many Mediterranean dairy sheep breeds. Among them the Sarda breed does not seem to have optimal conditions for an accurate breeding value estimation because of the typical reproduction system. In spite of recent spreading of artificial insemination (around the 15% of yearlings born in the Flock Book in '96 were from AI), it is still based on natural mating (NM) with a lack of genetic links across flocks not participating to the AI sire reference program (55% in '96). Furthermore, it involves one lambing per year in two main seasons: the autumn for the adult ewes and the early spring for the yearlings. The summer dry-off, almost simultaneous for all the ewes of the flock, causes a confounding between lactation length, lambing month, age and parity effects. In such a situation the choice of accurate preadjustments of lactation yields and the contemporary grouping strategy are very crucial points to remove the main sources of environmental variation without reducing connectedness. Up to '96, the genetic evaluation was applied on milk yield corrected for milking length (CMY) without preadjustment for age (Sanna *et al.* 1994b). The contemporary groups (CG) were exclusively formed by ewes of the same age class within flock-year (the age class corresponds approximately with parity). Recently a new milk trait called Equivalent Mature Ewe (EME) has been proposed to be used for the genetic evaluation (Carta *et al.* 1997). In comparison with CMY, EME is further on preadjusted for the interaction age class-parity-lambing month. The aim of this study was to compare two genetic evaluations based upon CMY and EME with a different definition of the CG.

MATERIALS AND METHODS.

The data set used for the genetic evaluations included the first four lactations performed from the ewes born after '82 with age at lambing lower than 54 months. All informative pedigrees up to grandparents of ewes born in the year '82 were included. h^2 and repeatability (R) were estimated from a data subset including the daughters born from known sire up to '92 to give all the ewes an opportunity to have four records. Data sets are summarized in Table 1. CMY were obtained projecting lactation yields to a reference length (162 d) with a set of multiplicative coefficients estimated taking into account for difference among maximum test day yields (Carta *et al.* 1997). The projection to EME was realized by multiplicative factors for the interaction age class-parity-lambing month (Carta *et al.* 1997). The model used for the CMY analysis included the interaction flock-year-age class. Years of production and birth began the 1st August and ended the next 31th July. Age classes (4 levels) were obtained by difference between year of production and birth. For the EME analysis, three CG were identified within flock-year: the yearlings, the mature ewes with lambings before the 15th December and the mature ewes with lambings after the 15 December. The two adult groups were formed considering that different management and seasonal conditions affect the yields of the adult ewes lambing late in the season. The interaction age class-parity-lambing month within year was included as a second fixed effect in the models for CMY and EME. Only the second age class was divided according to parity in two subclasses to distinguish first from second lactations. For each age by parity level 5 lambing month were considered, from December to April for yearlings and from November to March for adult ewes. This further additive correction was retained in the EME model to account for the pattern of age effects over time and also for the seasonal variation of pasture food availabilities. The estimates of h^2 and R were obtained by a sire model including male relationships using MTDFREML software (Boldman *et al.* 1993). The two indexations were realized with animal models and iterative procedures by the software JAA developed by I. Misztal. In order to point out the differences caused by the CG definition, the two genetic evaluations were realized assuming the same genetic parameters (h^2=0.28, R=0.45) used for the official indexation of '96.

Table 1. Description of the data sets

	Genetic evaluation	Estimation of genetic parameters
Females	366,042	127,393
Females with records	324,316	127,393
Records	756,522	343,537
Females birth years	'82-'95	'82-'92
Males	8,028	4,669
Sires of daughters with records	6,890	4,120

RESULTS AND DISCUSSION

Table 2 shows the genetic parameter estimates for both CMY and EME. Estimated h^2 coefficients are similar to the previously obtained for 1st lactation in the Sarda and in other dairy sheep breeds (Sanna *et al* 1994a; Barillet and Boichard 1994). Both the h^2 and R were lower than those previously estimated for CMY in a two flock analysis on Sarda ewes (Sanna *et al.*, 1997). EME showed higher additive genetic variance (V(a)) and h^2 than CMY, while R values were slightly different. Table 3 reports some statistics regarding the number of sires and CG. The grouping strategy used for the CMY analysis limited the number of compared rams within CG, mainly for the small flocks in which the annual replacement was generated by one or two NM rams. In the EME evaluation the inclusion of different age class ewes in the same group increased the average number of observations and sires per CG. These facts are expected to reduce the confounding between environmental and genetic effects in the adult CG, so improving the accuracy of fixed effect estimation and sire evaluation The Spearman correlations between EBV (table 4) showed that the grouping strategy used for the EME evaluation modified the genetic rank of the females and mainly of the NM sires. The rank of AI sires, which were evaluated in different flocks with a greater number of compared rams, was equivalent in the two evaluations. As an example, the CG involved in the indexation of a NM sire ranked 901st with the CMY and 6th with the EME analysis are described. The table 5 reports the number of daughters (Ndt) and contemporary lactations (Nct) with the difference between the respective average yields (dev). The EME evaluation involved a higher total Nct than CMY (104 *Vs* 70). The yearlings were equally grouped in the two evaluations and the related dev practically equivalent, but the CMY evaluation included a completely disconnected (Nct=0) 2nd age class CG. In the EME evaluation these 2nd age class lactations

Table 2. Means, standard deviations, estimated variance components[1], heritabilities and repeatabilities (R) for CMY and EME.

Traits	Mean (l)	sd (l)	V(a) (l^2)	V(p) (l^2)	V(e) (l^2)	h^2	R
CMY	202	57	357.2	168.4	853.1	0.26	0.38
EME	205	56	402.0	156.1	843.1	0.29	0.40

[1] V(p)=estimated permanent environmental variance, V(e)= estimated error variance.

Table 3. Number of CG and sires of daughters per CG in the two genetic evaluations

CMY evaluation CG:Flock-Year-Age class	
Number of CG	28,413
Number of CG with at least 1 known sire	24,260
Number of CG with 1 known sire	10,779
Average number of sires per CG	2.46
EME evaluation CG:Flock-Year-Age group-Lambing season	
Number of CG	29,539
Number of CG with at least 1 known sire	25,255
Number of CG with 1 known sire	8,420
Average number of sires per CG	3.01

Table 4. Spearman correlations coefficients between EBV for three categories of animals

Categories	Rank correlation
Sires of daughters with records used by NM (n=6,718)	0.91
Sires of daughters with records used by AI (n=172)	0.99
Females with records (n=324,316)	0.95

showed a high dev from the more aged ewes included in the same CG. The good average genetic merit of these contemporaries determined the rank variation. On the basis of these results multiplicative preadjustments for the interaction age class-parity-lambing month seem to be useful for genetic evaluations of dairy sheep. A better accuracy of EBV and a higher genetic gain can be expected by the increasing of h^2 and V(a). Furthermore, if the AI program is still insufficient to create genetic links across the flocks involved in the breeding scheme, the use of the EME with the inclusion of the adult ewes in the same CG, can be helpful to improve genetic connectedness. This study showed that NM rams exhibiting interesting average daughter yield are better emphasized by the EME indexation. However, an efficient AI reference sires program is still the more powerful tool for creating genetic ties across flocks (Barillet 1997).

Table 5. Description of the CG involved in a NM ram evaluation

CMY evaluation					EME evaluation					
Year	Age class	Nd	Nct	Dev (1)	Year	Age group	Season	Nd	Nct	Dev (1)
94	1	15	11	+6	94	1	----	15	11	+7
95	1	24	0	0	95	1	---	24	0	0
	2	14	10	+8		2	1	9	36	+35
						2	2	5	8	+9
96	1	5	17	-8	96	1	–	5	17	-3
	2	22	0	0		2	1	32	22	+32
	3	14	32	-4		2	2	4	10	+49

REFERENCES

Barillet, F. (1997) In "Genetics of the sheep" ed. CAB International, Wallingford, Oxon, UK

Barillet, F., Boichard, D., (1994) "Proc. 5th WCGALP", Vol. 17, p.111, ed. Univ. of Guelph.

Boldman, K.G., Kriese, L.A., Van Vleck, L.D., Kachman, S.D. (1993) "A manual for use of MTDFREML". Usda-Ars, Clay Center, NE

Carta,A., Sanna, S.R., Rosati, A., Casu, S. (1997) *Annal. Zootech.* (submitted)

Sanna SR., Carta A., Casu S., Moioli B.M., Pilla A.M., (1994a) *Zoot. Nutr. Anim.* **20**:247-251

Sanna SR, Carta A., Casu S., Pilla AM., Pagnacco G., (1994b) *Zoot. Nutr. Anim.* **20**: 313-318

Sanna, S.R., Carta, A., Casu, S. (1997) *Small Ruminant Research* **25**: 77-82.