

ESTIMATION OF GENETIC TREND OF FRIESIAN CATTLE POPULATION IN ITALY

Estimación del trend genético en la población italiana de ganado vacuno frisone

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INTRODUCTION

Friesian cattle, with 3.4 million heads, represent about 40% of the whole Italian cattle population and are the most relevant dairy breed in the Country. Over 75 % of all the officially milk recorded dairy cows in 1980 were Friesian, with 83,974 first lactations and 234,558 records of older cows.

In recent years considerable emphasis has been given to the improvement of the productivity of these cattle, by the introduction of new feeding, milking and management techniques and by the importation of subjects of higher genetic merit.

In this framework it seemed interesting to assess the genetic trend for milk production among Italian Friesian cows.

MATERIAL AND METHODS

The survey was performed on first lactation records of registered Friesian cows on official test, born from January 1966 to December 1976, in the provinces of Brescia, Cremona, Mantova, Milano, Parma and Reggio Emilia, located in the Po valley where the Italian dairy industry is mainly concentrated.

Only actual milk yield records, up to 305 days, were considered, with no adjustment factors.

Records were excluded if they were from lactations initiated before 29 or after 38 months of age, less than 240 days in length, from a herd where no herdmates were present. Herdmates were other first lactation cows, calving in the same herd-year-season. On the basis of a preliminary survey, the seasons were defined as March through June, July through October and November through February.

Furthermore the record of a cow was included only if data on milk production of its dam, with the same restrictions as above, were also available.

Out of an initial sample of 113,591 first lactation records, 36,389 cows, from 1606 herds, satisfied the stated restrictions and were thus considered and analysed. Cremona provided the bulk of the data (56 %), followed by Milano (14 %), Brescia (12 %), Mantova (7 %) Parma (6 %) and Reggio Emilia (5 %).

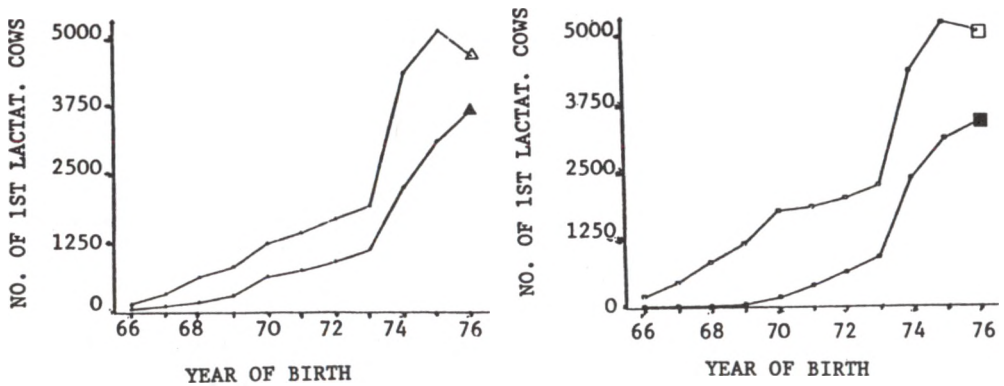
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There were 8,580 herd-year-season subclasses, with a mean of 4.2 cows. The subclass mean for the number of sires was 2.2. The mean number of herdmates per cow was 6.1.

The sire of each cow was identified and the cows were classified according to whether they had been sired by natural (N.I.) or artificial (A.I.) insemination and by bulls born in Italy or abroad.

The sample size per year of birth of the considered cows, is represented on figure 1, according to the insemination method and to the origin of the sire.

FIGURE 1 - Sample size, per year of birth, of first lactation cows sired by Natural (Δ) or Artificial (\blacktriangle) insemination and by Italian (\square) or Non-italian (\blacksquare) bulls.



The estimation of genetic and phenotypic trends were obtained as intraherd regressions on time of birth, as outlined by POWELL and FREEMAN (1974). In particular the phenotypic trends were estimated as intraherd (H) regressions of milk production (P) on time of birth (T) (i.e. $b_{P.T/H}$); the genetic trends were estimated as:

$$\hat{g} = \frac{-2 (b_{(P-\bar{P}).T/HS} - \frac{\Delta D}{2})}{1 + \Delta A}$$

where:

$b_{(P-\bar{P}).T/HS}$ is the regression coefficient of the difference of milk production of the considered first lactation cows (P) from the herdmate mean (\bar{P}) on time of birth (T), within herd (H) and sire (S);

ΔD is an adjustment for the merit of the dam, i.e. for the possibility that older sires are mated to cows of above average merit. It is estimated as:

$$\Delta D = h^2 b_{(DP-\bar{DP}).T/HS}$$

h^2 is an estimation of heritability of milk yield, obtained as twice the regression, within herd-sire subclasses, of the deviation of milk production ($P-\bar{P}$) on the deviation of the milk production of the dams ($DP-\bar{DP}$). The rest of the equation is the trend of the dam production on time, within herd and sire;

ΔA is an adjustment for the age of the dam, based on the deviation within sires from random mating with respect to age of the dam. It is estimated as:

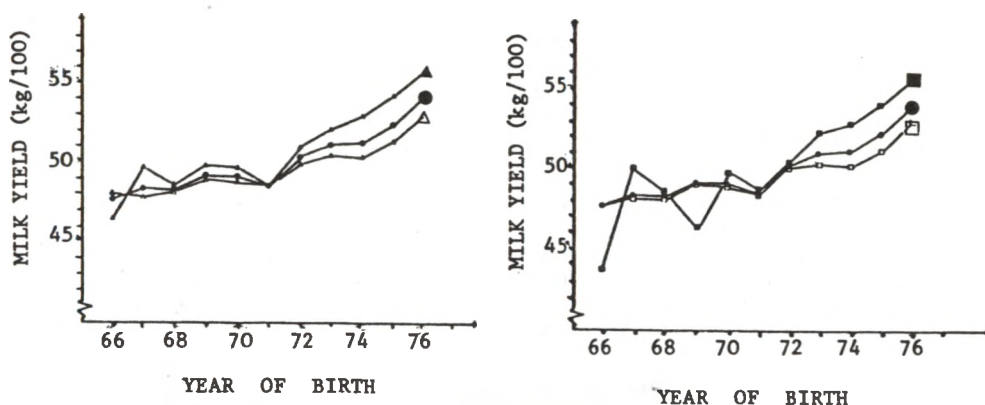
$$\Delta A = b_{DA.T/HS} - b_{DA.T/H}$$

where $b_{DA.T/HS}$ and $b_{DA.T/H}$ are the regression coefficients of dam age in years (DA) on time of birth, within herd and sire, and within herd respectively.

RESULTS AND DISCUSSION

The milk yield dynamics in the considered population, from 1966 to 1976, are plotted on figure 2, according to method of insemination and origin of the sires. The estimates of phenotypic trends are given on table 1, together with the average values of milk production of the studied cows.

FIGURE 2 - Average milk yield, per year of birth, of first lactation cows: total sample (●), sired by Natural (Δ) or Artificial (▲) insemination and by Italian (□) or Non-Italian (■) bulls.



As regards the genetic interpretation of the trend, on the same table are reported the estimates of genetic trend and of the heritability of milk production, together with ΔA and the dam regression, within herd and sire.

The genetic trend over the total sample was 42 kg of milk per year, about 50 % of the phenotypic estimate and 0.8 % of the mean yield.

TABLE 1 - Estimate of parameters (+ SE)

Parameters	Total sample	by method of insemination		by origin of the sire	
		sired by NI	sired by AI	Italian	Non-italian
Size of sample (no. of cows)	36,389	22,945 ⁽¹⁾	13,551 ⁽¹⁾	25,223	11,166
Mean of milk yield (kg)	5157 + 5.3	5069 + 6.6	5303 + 8.7	5064 + 6.2	5366 + 9.9
Phenotypic trend of milk yield (kg per year)	84.2 + 2.3	77.6 + 2.9	90.7 + 4.2	77.4 + 2.7	110.3 + 6.4
Genetic trend of milk yield (kg per year)	42.3 + 5.9	43.3 + 7.6	37.7 + 10.1	39.0 + 6.5	58.4 + 13.6
h^2 of milk yield	0.22 + 0.01	0.20 + 0.01	0.27 + 0.02	0.22 + 0.01	0.23 + 0.02
Dam trend within herd and sire (kg per year)	19.6 + 6.4	18.3 + 8.5	26.4 + 10.1	15.9 + 7.1	35.4 + 14.5
ΔA (years) ⁽²⁾	0.13 + 0.01	0.18 + 0.02	0.06 + 0.02	0.14 + 0.01	0.08 + 0.03

(1) 107 cows were sired by bulls used both for NI and AI; (2) see text

If the disaggregation by origin of the sire is examined, the greatest phenotypic (110 kg per year) and genetic (58 kg per year) trends in milk yield were given by the Non-italian sires. It should be noted that the number of cows sired by imported sires was about 30 % of the total sample and their incidence did continuously increase over the considered period (see fig. 1) to reach 40 % in 1976.

As far as the insemination method is concerned, a higher phenotypic trend was shown in the cows sired by A.I. (91 vs 78 kg), but the genetic contribution was lower with artificial in comparison to natural insemination (42 % vs 56 %). A further investigation on these results may be of particular interest to optimize the breeding strategy in the Country.

The values of the dam trends, within herd and sire, are an index of the tendency to mate older bulls to cows with higher milk production. The parameters were greater for Non-italian or A.I. sires in comparison to Italian or N.I. sires, even if the differences are not significant. It should be remembered that non random mating of bulls during progeny testing affects the estimate of their breeding value.

The ΔA values show that each year that a sire was in service he is likely to be mated to cows 1.7 or 2.2 months older, res-

pectively with the Italian sires or with those used for N.I., whereas the deviation from random mating, with respect to age, was not relevant with Non-italian or A.I. sires.

The heritability values for milk yield were in accordance with the literature. These estimates were here based on daughter-dam regressions, thus the higher values found for the cows sired by A.I., can be an index of non random mating of A.I. sires.

SUMMARY

The estimation of genetic trend of milk production in the most relevant dairy cattle population of Italy can be of value for a critical analysis of the breeding strategy of the Country.

Genetic trend is estimated, on a sample of over 36,000 heifers, from intraherd regression of milk yield level on time of birth, within a range of eleven years.

The results are discussed in relation to the phenotypic trend and to the impact of imported vs local sires and of the methods of insemination.

RESUME

L'estimation du trend génétique de la production laitière de la population de vaches à lait plus importante d'Italie peut être utile pour une analyse critique de la stratégie nationale de la sélection.

Le trend génétique a été estimé sur plus de 36.000 premières lactations, par une régression intratroupeau du niveau de la production laitière sur le temps de naissance, pour une période de onze ans.

Les résultats sont discutés par rapport au trend phénotypique et à l'impact des reproducteurs importés et des méthodes d'insémination.

REFERENCES

POWELL R.D. and FREEMAN A.E. (1974): Genetic trend estimates. J. Dai. Sci., 57: 1067-1075.