SELECTION FOR TOTAL MERIT IN THE SPANISH HOLSTEIN FRIESIAN

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INTRODUCTION

The objective of a breeding program is to maximise profit. Direct selection for profitability required to determine a selection index with estimated economic weights and traits recorded in a large population. Those weights are difficult to derive and apply because some traits are not available from a wide population.

Assuming that profitability can be defined by the product of productivity per unit of time by the period of herd life or longevity,. an indirect selection index can be derived to improve profitability.

An index is efficient if it produces a positive genetic selection response in profitability and it is accepted by the dairy cattle industry. A direct selection on traits with low heritability or large generation interval is inefficient. This is the case of longevity traits. A solution could be the inclusion in the index of correlated traits.

There are two definitions for longevity, True Herd Life (THL) and Functional Herd Life (FHL). Ducrocq et al (1988) defined THL as the ability of a cow to survive in a herd by delaying voluntary and involuntary culling and FHL as the ability of a cow to avoid involuntary culling. THL is the time between last and first calving of a cow, and FHL is calculated as THL corrected by milk production.

Selection against involuntary culling is desirable to improve genetic responses on production (greater intensity of selection) and on profitability (reduction of replacement cost). Selection on production traits is related with productivity and voluntary culling (culling of low productive animals). Recorded traits related with involuntary culling are conformations and may be other functional traits as somatic cells counts or milking speed and disease incidence and fertility traits.

Production and conformation traits are regularly recorded to evaluate large number of cows in the Spanish population. Both production and selection traits are important components of breeding and selection decisions for the Spanish dairy cattle industry. An index that combines breeding values for production and type traits is widely accepted to rank bulls and cows.

Weights of the Spanish selection index for total merit were derived on expected responses in longevity, production and conformation traits. This study presents how genetic parameters and genetic responses have been derived.

MARTERIAL AND METHODS

Data refer to 769282 lactations from the Spanish official milk recording and 235248 cows classified between 1984 to 1992 by official classifiers of the Spanish Friesian Associations (CONAFE). Conformation traits were 6 Score card traits (Final Score, Capacity, Feet and Legs, Mammary System, Dairy Character and Rump) and 20 linear descriptive traits. Linear traits were Size, Stature, Style, Angularity, Head, Chest, Loin strength, Body depth, Rump Width, Pin setting, Set of rear legs, Bone quality, Foot angle, Udder texture, Udder depth, Median suspensory ligament, Fore udder attachment, Rear udder attachment, Fore teat placement and Rear teat placement.

Longevity data were obtained of records from cows first calving before 1988 in herds continuously enrolled in the recording program in order to allow for at least five years of productive life. Contemporary groups (herd-

year) of at least 5 cows were required. 79308 cows from 3212 herds were selected. THL was defined as months between first and last calving. FHL was calculated by adjusting THL by linear and quadratic covariables of standardised milk yield of first lactation.

Variance estimation was carried out on random samples of data about 10000 cows with records and 18000 animals. Means of sample estimates are reported as global estimates. A canonical transformation, since all traits had equal incidence matrices, REML and a computational strategy as described by Misztal et al (1992) were used to estimate (co) variance components.

Number of records used to estimate correlations between production traits and longevity, score card traits and linear descriptive traits were 21882, 58269 and 34433, respectively. Genetic correlations between longevity traits and Score card traits and linear descriptive traits were based on 31577 and 24764 cows respectively.

RESULTS

Average number of lactations, years of functional and total herd life were 3.32, 3.36 and 5.65, respectively. Heritabilities for FHL and THL,.08 and .07 respectively, were low but slightly higher than those reported by Bagnato (1993) and Boldman et al (1992) and similar to those reported by Short and Lawlor (1992).Heritabilities for Production and Conformations traits reported in this study were lower than those estimated more recently in the Spanish population with all data available. Heritabilities are presented in table 1.

Genetic and phenotypic correlations between production , conformation and longevity traits (THL and FHL) are presented in table 2. In general correlations are similar of those estimated by Bagnato (1993) and Short and Lawlor (1992). All phenotypic correlations are almost equal to 0. Production traits are most correlated with THL, .38, .40, .31 for Milk, Fat and Protein Kg., respectively. Among conformation traits, Final Class (.25), Dairy character (.25) and Mammary System (.27) show the highest correlations. THL is negatively correlated with traits related with size, Capacity(-.07), Size (-.14),Chest (-.30), Body Depth (-.24), Rump Width (-.11).

Correlations with FHL were lower. As expected, correlation between Milk production and FHL was equal to 0. Highest correlation with FHL are Kg. and % Fat (.18 and .20), Final Class (.19) Mammary System (.22)and Udder Depth (.24). As with THL, FHL is negatively correlated with traits related with size (Capacity, Stature, Size, Body Depth, Rump). Results reported by Bagnato (1993) and de Jong (1994) show a quadratic relationship between FHL and Capacity. Similar negative genetic correlations were reported by Bagnato (1993), Boldman et al (1992) Rogers et al (1989), Short and Lawlor (1992) and Van Der Werf (1992).

Selection responses using different selection index weights on production and type traits were presented to the Spanish Holstein Association. Genetic selection responses by applying the previous shown Spanish genetic parameters to diverse index are presented in table 3. The chosen index, ICO95, was :

ICO95 = 2 (Kg. Fat + 5 Kg. Prot. + .5 % Prot.) + 1(.5 F&L.+ 2 FC.+ 2 MS)

The criteria of the Spanish breed association in selecting that index was to obtain a positive response on protein test with large responses on FHL, Kg. Protein and Mammary System. In general, it can be said that the type-production indices (ICO, TPI, LPI and ILQM) applied in different countries produce similar responses, improvement around 15 days on FHL and 13.5 Kg. of protein. The indices that include only production traits (INET and RZM) show a low response on FHL and larger responses on production traits than the indices that include conformation traits.

GENERAL DISCUSSION

The selection index (ICO95) is generally accepted by the Spanish Dairy cattle industry to

rank bulls and cows. Responses on FHL have helped to more objectively determine weights on conformation traits. Feet and Legs is an important trait for the Spanish industry but in all studies it shows low heritability and low genetic correlations with longevity traits.

Other studies are in progress in Spain to improve the selection for total merit. The benefit of the inclusion in the index of other secondary recorded traits, such as somatic cell count, should be studied in a similar way than in the present study, if economic data are not available on a large sample of the population.

Economic data should be used to derive indices that directly improve profitability. Data on economic information (labour, feed, veterinary costs) are recorded in some regions of Spain. Some of those data will be processed to determine if the inclusion of economic weights on traits derived from those studies maximised profit.

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Table 1. Longevity, production and conformation heritabilities

Traits	h^2
THL	.08
FHL	.07
Milk	.29
Fat	.27
Fat %	.34
Protein	.25
Protein %	.39
Final Class (FC)	.28
Capacity (CAP)	.33
Dairy Character (DC)	.28
Rump (RMP)	.14
Feet and Legs (FL)	.14
Mammary system (MS)	.27
Size (SZ)	.23
Stature (STA)	.32
Style (STY)	.17
Angularity (Ang)	.20
Head (HD)	.14
Chest (Ch)	.23
Loin (LO)	.13
Body depth (BD)	.19
Rump width (RW)	.16
Pin Setting (PS)	.19
Foot Angle (FA)	.07
Bone quality (BQ)	.17
Side Rear legs (SRL)	.11
Udder Texture (UT)	.18
Fore Udder Attachment (FAT)	.20
Rear Udder Attachment (RAT)	.20
Median Suspensory Ligament	.18
(MSL)	.14
Udder depth (UD)	.22
Fore Teat Placement (FTP)	.19
Rear Teat Placement (RTP)	

Table 2. Estimates of genetic and phenotypic correlations between THL, FHL and production and type traits

Traits	THL		FHL	
	Gen.	Fen.	Gen.	Fen.
Milk	.38	.17	.01	.00
Fat	.40	.18	.18	.02
Fat %	.10	.01	.20	.03
Protein	.31	.15	.02	.01
Protein %	-.26	-.03	.01	.01
FC	.25	.13	.19	.10
CAP	-.07	.01	-.12	.00
DC	.25	.09	.07	.04
RMP	.18	.06	.15	.04
FL	.14	.05	.11	.03
MS	.27	.12	.22	.10
SZ	-.14	.04	-.18	.03
STA	-.02	.04	-.07	.03
STY	.01	.08	-.01	.06
Ang	.15	.07	.01	.04
HD	.10	.05	.01	.03
Ch	-.30	.01	-.31	-.01
LO	.12	.05	.04	.03
BD	-.24	.04	-.28	.02
RW	-.11	.02	-.12	.02
PS	.23	.00	.26	.00
FA	-.06	.03	-.07	.02
BQ	.07	.05	.00	.03
SRL	.03	.00	-.03	.00
UT	.14	.07	.07	.06
FAT	.14	.07	.13	.06
RAT	.23	.09	.12	.07
MSL	.01	.07	-.08	.05
UD	.11	.05	.24	.02
FTP	.14	.04	.15	.02
RTP	.08	.05	.02	.02

Table 3: Genetic responses applying Spanish genetic parameters to divers indexes from different countries.

	THL[1]	FHL[1]	Milk[2]	Fat[2]	Prot[2]	Prot %	FC[3]	CAP[4]	FL[4]	MS[4]	UD[5]
LPI Canada	54.5	14.5	450	15.8	13.3	-0.012	1.1	3.0	2.2	3.4	-0.05
TPI USA	59.0	17.4	454	16.3	13.6	-0.009	1.1	2.5	1.7	3.3	-0.05
ILQM Italy	53.1	15.1	408	15.5	13.4	0.011	1.0	2.1	1.4	3.4	-0.04
ISU France	44.3	7.9	421	14.8	13.8	0.029	0.9	2.6	1.5	2.8	-0.07
INET N.D.	50.4	2.0	500	16.3	15.0	-0.008	0.5	1.1	0.8	1.5	-0.14
PIN II UK	48.0	13.8	390	14.5	11.7	-0.03	1.3	3.1	2.1	4.2	-0.02
RZM Germany	52.1	3.8	499	16.6	15.0	-0.008	0.5	1.1	0.8	1.5	-0.14
ICO Spain	55.7	15.9	445	15.9	13.6	+0.0004	1.1	2.6	1.7	3.3	-0.05

[1] Days; [2] Kg. ; [3] Points (Scale 62 to 90); [4] Points (Scale 0 to 100); [5] Points (Scale 1 to 9)

LPI (Canada): 49% Protein, 11% Fat, 18.8% MS, 14.8% FL, 3.6% FC, 3.6% Capacity
TPI (USA): 16.6% Fat, 50% Protein,16.7% FC, 16.7% MS
ILQM (Italy): -21.4% Milk, 5.2% Fat, 53.4 % Protein, 20% MS
ISU (France): 53.9% Protein, 16% Protein%, 7.6% CAP, 2.5% FL, 15% MS
INET (N. D.) : -27.8% Milk, 13.5% Fat, 58.7% Protein
PIN II (UK): -5.3% Milk, 7.6% Fat, 37.6% Protein, 13.3% Ang, 6.2% FL, 30% MS
RZM (Germany) : 20% Fat, 80% Protein
ICO (Spain): 51% Protein, 5.1% Prot. %, 10.3 % Fat, 14.8% FC, 14.8% MS, 3.7% FL.