Changes in Selection of Italian Holstein

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Abstract

Official genetic evaluation procedures are constantly under revision with the main aim of improving accuracy of estimated breeding values. At the same time for the farmers the economical importance of functional traits is increasing over time. In order to improve accuracy of proofs since 2007 a multiple trait genetic evaluation for conformation traits has been developed and run in parallel with the official single trait evaluation. Analysis of results over time have shown that the accuracy of proofs and their stability increases with the introduction of the multiple trait model. Therefore it has been decided to move the official genetic evaluation for conformation traits from single to multiple trait starting in August 2009. At international level a new final score definition has been developed that aims at improving functional conformation. Together with the multiple trait evaluation for conformation traits a procedure to derive final score EBV from linear traits has been developed and will be introduced in August 2009. After the introduction of official fertility evaluation in February 2006 discussions were ongoing about the need to include fertility within the selection index (PFT) for the Italian Holstein. After one year of discussion with the farmers representative the aggregate index for fertility will be included with a 10% relative importance in PFT starting with the evaluation August 2009. This change along with the changes related to conformation traits will move selection in Italy toward a more functional cow.

Keywords: genetic evaluation, selection index, final score

Introduction

Changes in selection in a country may be related to the accuracy of genetic evaluation, traits that are being evaluated and the official selection index definition.

Improving the accuracy of EBVs is a never ending process that aims at providing the farmers with the most accurate breeding values i.e. more able to predict the future values of their stocks over time.

With the evaluation of August 2009 in Italy all these three aspects will be touched.

The first change is related to the methodology used for the official genetic evaluation for conformation traits. Since 1991 the same procedure has been in place for conformation traits genetic evaluation. It was a single trait animal model that used all scores on first parity cows. Over time new traits were added but the model was never changed. The advantages of a multiple trait evaluation are an increased accuracy of proofs and the estimation of breeding values for all traits, even for animal who were not directly scored for a new trait.

The second change is related to a new definition of final score that will select more for functional conformation as suggested by the international WHFF classifiers group.

The third is the inclusion of fertility in the official selection index PFT, which was introduced in February 2002 and never changed in its definition since then (Biffani *et al.,* 2002).

All three changes can be seen in line with what is happening in the selection of the Holsteins at international level where the emphasis overall is now being given more and more to functional traits.

The objective of this paper is to briefly describe the changes that have been introduced and their impact on the selection of the Holstein breed in Italy.

Materials and Methods

Conformation traits

Around 260000 animals are scored for 19 linear conformation traits on a scale from 1 to 50. These are the data used for the genetic evaluation.

Six samples of around 15000 animals were used to estimate genetic parameters among the 19 different traits that are currently scored for conformation.

The same model was used for all the traits: fixed effects included herd-year-round of classification and the interaction between age, stage of lactation and a two year time frame. The only random effect was the animal. The same model was then used for the genetic evaluation.

REMLF90 package developed by I. Misztal and coll. was used for the analysis. The results from the 6 samples were then averaged to build the final variance covariance matrix.

Those parameters were then used on the total data set used for genetic evaluation that included data from 1998 to date.

Data set consisted of around 2 millions first classification records related to the same number of cows and to around 33000 sires.

For the evaluation MTJAA program 3.8 modified by Nicolas Gengler was used.

Results were compared with the single trait evaluation, in terms of accuracy, EBV correlation and genetic trend.

Final Score

Following the recommendations of the WHFF classifiers group, a set of equations were derived to estimate a phenotypic value for each of the classified cows.

The new definition gives 20% weight to Frame, 20% weight to Dairy Strength, 20% weight to Feet&Legs and 40% weight to Udder.

Genetic parameters were estimated between the 15 standard linear traits that have been collected since 1984 and the newly defined Final score. Ten different samples of around 15000 animals were analyzed using REMLF90 and then averaged to obtain the final variance covariance matrix.

Based on those genetic parameters selection index theory was then applied in order to find the best combination of the 15 linear traits that would optimize selection for the “NEW” Final Score.

EBVs results for this NEW Final score derived from linear traits were compared with the official EBVs for final score computed using a single traits animal model using Final Score phenotypic values.

PFT

Expected genetic progress was used to assess the optimal weight to be given to fertility in the Italian selection index. Genetic correlations with the actual PFT were then computed in order to assess the impact of the change on the official ranking.

Results and Discussion

Conformation traits

Table 1 reports the variance covariance matrix among the 19 linear traits.

Correlations between EBVs for single and multiple trait were very high, close to 0.98 for all traits. Correlations for Udder Composite EBVs were also very high at 0.987. EBVs for Feet&Legs showed a lower correlations, around 0.96, mainly due to the fact that now all animals have EBVs estimated through the correlations even if they do not have daughters directly scored for rear leg, rear view, or for functionality of Feet & Legs.

Genetic trend was slightly different only for traits that did not have data for all time period of the evaluation.

Average accuracy of EBV from the multiple trait was higher compared to single trait methodology, as expected.

In subsequent runs multiple traits evaluation showed an increased stability compared to single trait.

Final Score

Figure 1 reports the relative importance that each linear traits had in the definition of the "NEW" Final Score at phenotypic level.

Figure 2 report the relative importance that each linear traits has in the formula for the combined EBV and in total linear traits related to Frame and Dairy Strength have a relative emphasis of 29.6%, Feet &Legs linear traits have a weight of around 27% and Udder around 42.8%.

The two figures are somehow similar but they are not identical since they are referring to two different levels: phenotypic the first, genetic the second.

The "NEW" Final score seems to give more weight to functional traits like Feet & Legs.

Figure 3 show the increase in accuracy of the "NEW" final score compared to the actual. Correlation between the New Final Score and the actual Final score is around 0.93 and some reranking of bulls and cows is expected to occur when it will be introduced.

PFT

Table 1 show the relative weight given to each traits in the new selection index formula. Fertility has been included with 10% relative weight and the relative importance of production traits was reduced accordingly. The 10% weight was the minimum required to acquire a 0 expected genetic progress over 10 years (Figure 2).

Conclusions

Multiple trait evaluation for conformation traits has proven to be more stable and accurate compared to the actual single trait evaluation official since July 1991.

The new final score will allow a fair comparison between old and new bulls and between Italian and Foreign bulls.

The updated PFT will allow Italian selection to stop the decrease in fertility.

All these changes will be introduced in the August 2009 official evaluation.

References

Biffani, S., Samorè, A.B. & Canavesi, F. 2002. PFT: the new selection index for the Italian Holstein. *Interbull Bulletin 29*, 142.

Table 1. Heritability and genetic correlations among conformation traits.

	ST	CW	BD	AN	RA	RW	RLS	FA	FU	RUH	RUW	UD	US	FTP	TL	RLRW	FL	CO	RTP
ST	**0.40**	0.70	0.71	0.30	0.09	0.56	0.01	0.36	0.18	0.28	0.23	0.26	0.30	0.18	0.13	0.19	0.23	0.60	0.13
CW		**0.25**	0.93	-0.12	0.01	0.55	-0.10	0.34	0.05	0.00	0.13	0.09	0.03	0.13	0.15	0.18	0.13	0.40	0.14
BD			**0.30**	0.13	-0.02	0.54	0.05	0.31	0.04	0.13	0.24	0.14	-0.06	0.16	0.16	0.15	0.11	0.46	0.14
AN				**0.23**	-0.07	0.17	0.38	0.05	0.16	0.59	0.50	0.37	-0.05	0.20	-0.08	0.10	0.22	0.56	0.00
RA					**0.23**	0.03	-0.10	0.08	-0.16	-0.15	-0.04	-0.09	-0.07	-0.04	-0.05	-0.02	-0.02	0.02	-0.03
RW						**0.22**	0.11	0.18	0.20	0.21	0.33	0.24	0.12	0.13	-0.02	0.12	0.17	0.45	0.08
RLS							**0.16**	-0.48	0.06	0.02	0.12	0.05	-0.07	0.11	0.00	-0.44	-0.43	-0.06	-0.02
FA								**0.10**	0.18	0.24	0.08	0.22	0.25	0.16	0.03	0.67	0.71	0.48	0.05
FU									**0.20**	0.46	0.28	0.43	0.73	0.59	-0.23	0.19	0.28	0.38	-0.15
RUH										**0.21**	0.65	0.50	0.20	0.26	-0.07	0.20	0.30	0.44	0.02
RUW											**0.16**	0.37	-0.13	0.34	-0.11	0.14	0.18	0.35	0.02
UD												**0.16**	0.30	0.48	-0.09	0.18	0.30	0.40	-0.01
US													**0.30**	0.34	-0.14	0.12	0.15	0.21	-0.16
FTP														**0.19**	-0.38	0.17	0.24	0.33	-0.33
TL															**0.19**	0.03	0.02	0.08	0.88
RLRW																**0.06**	0.85	0.51	0.16
FL																	**0.10**	0.66	0.25
CO																		**0.14**	0.35
RTP																			**0.18**

Table 2. New PFT: relative percent weight of each trait.

Production	Weights	Functionality	Weights
Milk	0	TYPE	4
Fat	8	ICM	13
Protein	36	Feet&Legs (IAP)	6
Fat %	2	Somatic cells	10
Protein %	3	Functional longevity	8
		Fertility	10

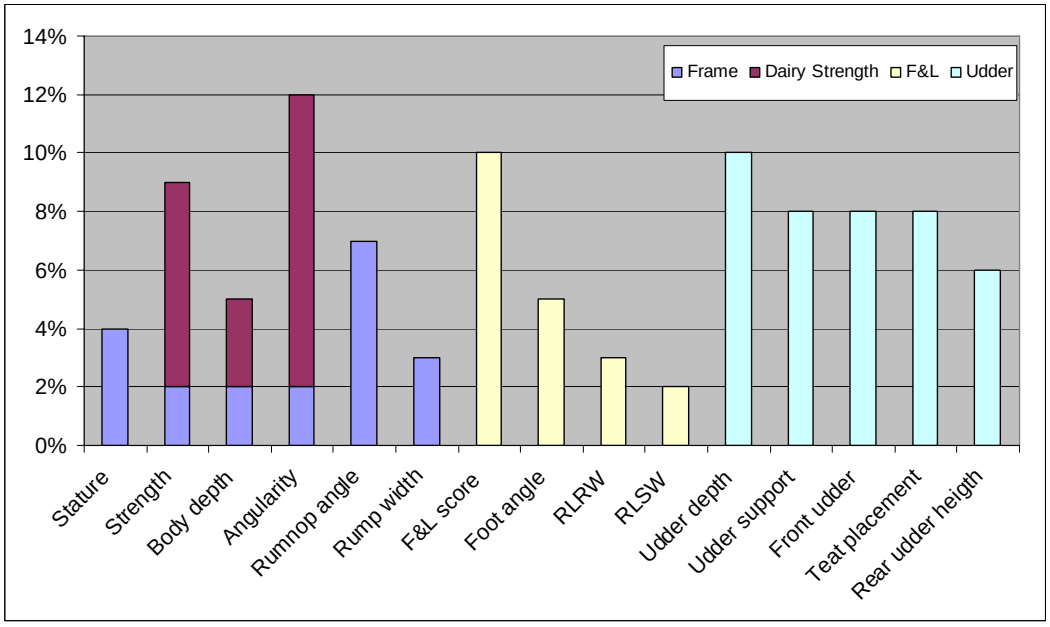

Figure 1. The relative importance of the 15 standard traits in the definition of the "NEW" Final Score at phenotypic level.

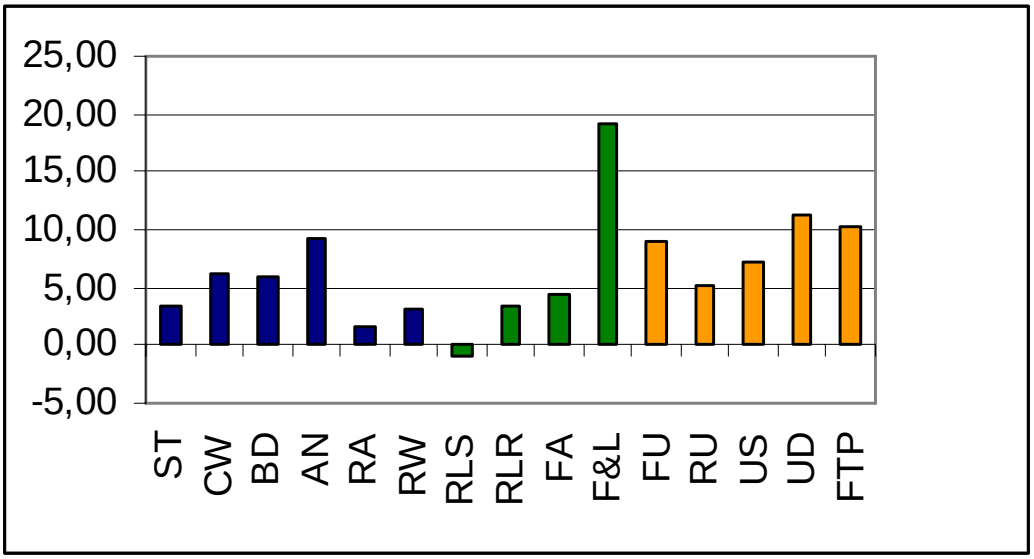

Figure 2. Relative percent weight of the 15 traits in the EBV for Final Score.

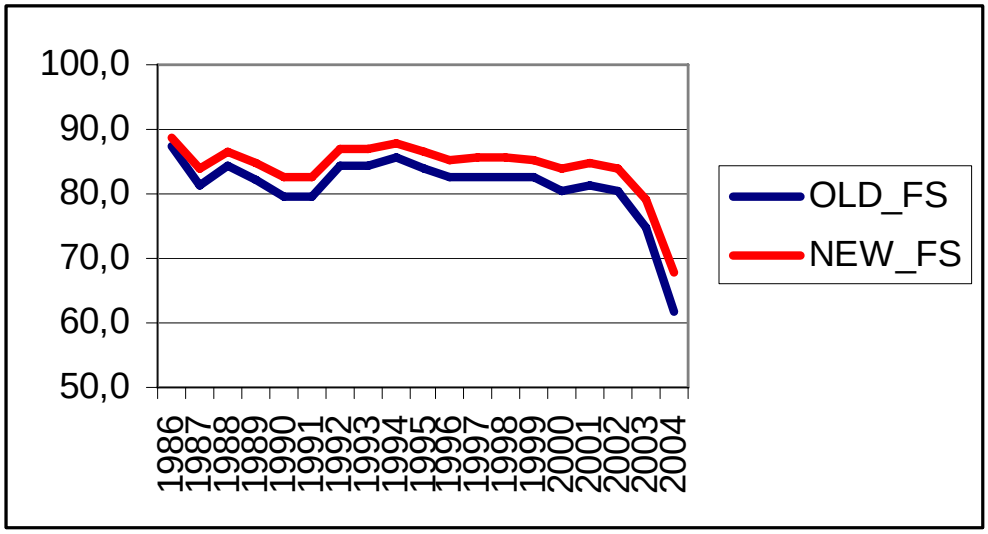

Figure 3. Average reliability level by bull's birth year.

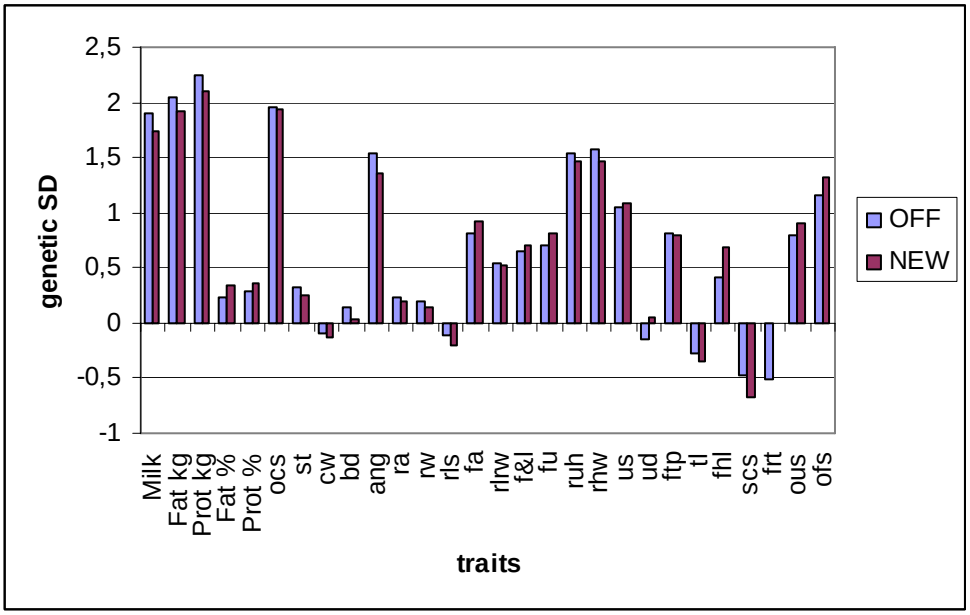

Figure 4. Expected genetic progress in 10 years.