Prediction of gross feed efficiency in Italian Holstein Friesian bulls

Finocchiaro, R., Penasa, M., Marusi, M., De Marchi, M., Cassandro, M.

Poljoprivreda/Agriculture

ISSN: 1848-8080 (Online)
ISSN: 1330-7142 (Print)

http://dx.doi.org/10.18047/poljo.21.1.sup.18

Poljoprivredni fakultet u Osijeku, Poljoprivredni institut Osijek

Faculty of Agriculture in Osijek, Agricultural Institute Osijek

ISSN 1330-7142
UDK: 636.084.522:636.234.2
DOI: 10.18047/poljo.21.1.sup.18

PREDICTION OF GROSS FEED EFFICIENCY IN ITALIAN HOLSTEIN FRIESIAN BULLS

Finocchiaro, R.[(1)], Penasa, M.[(2)], Marusi, M.[(1)], De Marchi, M.[(2)], Cassandro, M.[(2)]

Original scientific paper

SUMMARY

The aim of this study was to predict gross feed efficiency of Italian Holstein Friesian bulls selected for production, functional and type traits. A total of 12,238 bulls, from the April 2015 genetic evaluation, were used. Predicted daily gross feed efficiency (pFE) was obtained as ratio between milk yield (MY) and predicted dry matter intake (pDMI). Phenotypic trend for MY, predicted body weight (pBW) and pFE were calculated by the bull birth year. The results suggest that pFE can be successfully selected to increase profitability of dairy cattle using the current milk recording system. Direct measurements on DMI should be considered to confirm results of pFE obtained in the present study.

Key-words: gross feed efficiency, correlation, genetic trend, Holstein Friesian bulls

INTRODUCTION

Improving feed efficiency is a hot topic in dairy cattle breeding. Feed costs are a major proportion of the total costs of the dairy herd and thus reducing feed costs for the same output will improve farm profitability. Another benefit from improving feed efficiency is the reduction of greenhouse gases emissions (Hegarty et al., 2007; Wall et al., 2007; Cassandro et al., 2010, 2013). Several countries have set up projects to record dry matter intake (DMI) data (Veerkamp et al., 2000; de Haas et al., 2012; Pryce et al., 2014), but the recording of large datasets to estimate genetic parameters for feed efficiency is complicated and expensive. One way to obtain estimated breeding values (EBV) for traits difficult to collect at population level is to use genomic selection (Meuwissen et al., 2001), where phenotypes such as DMI are measured in a subset of the population, and genomic predictions are calculated for other animals that have genotypes but not phenotypes (Pryce et al., 2014). Although this approach is appealing, allowing industry-wide selection for improved efficiency, the size of the reference population from which the genomic prediction equations are derived is currently too small within each country to achieve satisfactory levels of accuracy of genomic breeding values (Verbyla et al., 2010). Another way to obtain EBV for feed efficiency is to predict this trait by combining official milk recording data and type traits. The aim of this study was to predict gross feed efficiency of Italian Holstein Friesian bulls selected for production, functional and type traits, and to assess phenotypic correlations of gross feed efficiency with milk yield and composition traits.

MATERIAL AND METHODS

A total of 12,238 bulls, from the official April 2015 genetic evaluation performed by the Italian Holstein Friesian Cattle Breeders Association (ANAFI), were used. Estimated breeding values (EBV) for milk yield (MY, kg/305 d), fat content (FAT, %/305 d), protein content (PRT, %/305 d), stature and body depth rescaled on phenotypic data of cattle born in the period 2007-2009, were provided by ANAFI. Predicted body weight (pBW, kg) was calculated as proposed by Cassandro et al. (1997). Dry matter intake (pDMI, kg/305 d) was derived using information of MY, FAT, and pBW for each bull, as reported by Chase and Sniffen (1985). Daily gross feed efficiency (pFE) was predicted as ratio between MY and pDMI. Phenotypic trend for MY (kg/305 d), pBW and pFE was calculated by birth year of bulls. Pearson cor-

(1) Ph.D. Raffaella Finocchiaro (raffaellafinocchiaro@anafi.it), M.Sc. Maurizio Marusi - Italian Holstein Friesian Cattle Breeders Association (ANAFI), Via Bergamo 262, loc. Migliaro, Cremona, Italy, (2) Assist. Prof. Mauro Penasa, Assoc. Prof. Massimo De Marchi, Prof. Dr. Martino Cassandro - University of Padova, Department of Agronomy, Food, Natural resources, Animals and Environment, Viale dell'Università 16, 35020 Legnaro (PD), Italy

relations and descriptive statistics were computed using SAS software version 9.2.

RESULTS AND DISCUSSION

Descriptive statistics and Pearson correlations for the studied traits are reported in Table 1. Predicted FE and BW averaged 1.47±0.07 and 669.1±4.7 kg, respectively, as well as means for MY, FAT and PRT were 10,144±701 kg/305 d, 3.72±0.22% and 3.39±0.11%, respectively. Unfavourable correlations were estimated between pFE and milk composition traits, whereas favourable relationship was assessed between pFE and MY. All correlations were statistically significant (P<0.001). Similar results were reported by Connor et al. (2013) and Manzanilla Pech et al. (2014), whereas Vallimont et al. (2011) reported greater estimates of pFE than those obtained in the present work.

Table 1. Descriptive statistics[1] for milk yield (MY), fat content (FAT), protein content (PRT), predicted body weight (pBW) and predicted gross feed efficiency (pFE) of Holstein Friesian bulls (n=12,238). Pearson correlations (r_p) of MY and pFE with other traits are also provided

Trait	Mean	SD	Minimum	Maximum	r_p with MY	r_p with pFE
MY, kg/305 d	10,144	701	7,734	12,711	-	0.94
FAT, %/305 d	3.72	0.22	3.02	4.76	-0.32	-0.61
PRT, %/305 d	3.39	0.11	2.91	3.93	-0.21	-0.37
pBW, kg	669.1	4.7	652.85	685.37	0.47	0.33
pFE	1.47	0.07	1.18	1.70	0.94	-

[1]SD = standard deviation

Trends of MY and pFE by the bulls birth year are depicted in Figure 1. Milk yield increased by 62 kg per year during the last three decades. This result represents the 0.56% of the current phenotypic mean. The pFE followed similar trend with an annual increase of +0.004 kg of MY per kg of DMI. This result represents the 0.26 % of the current phenotypic mean. The lower value for pFE compared with MY is the result of the indirect selection strategy used by ANAFI to improve feed efficiency. Figure 2 shows trends for pBW and pFE. Body weight increased by 0.27 kg/year which represents an annual increase of +0.04% of the current mean value of pBW. These findings suggest that feed efficiency can be improved together with milk traits. However, body weight should not increase further.

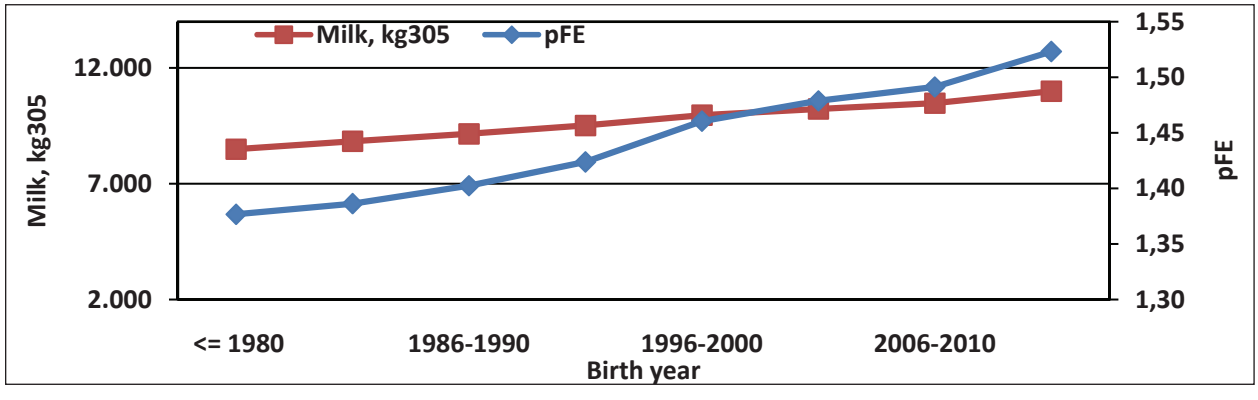

Figure 1. Trend of milk yield (MY, kg/305 d) and predicted feed efficiency (pFE) for Holstein Friesian bulls evaluated in Italy (ANAFI, April 2015)

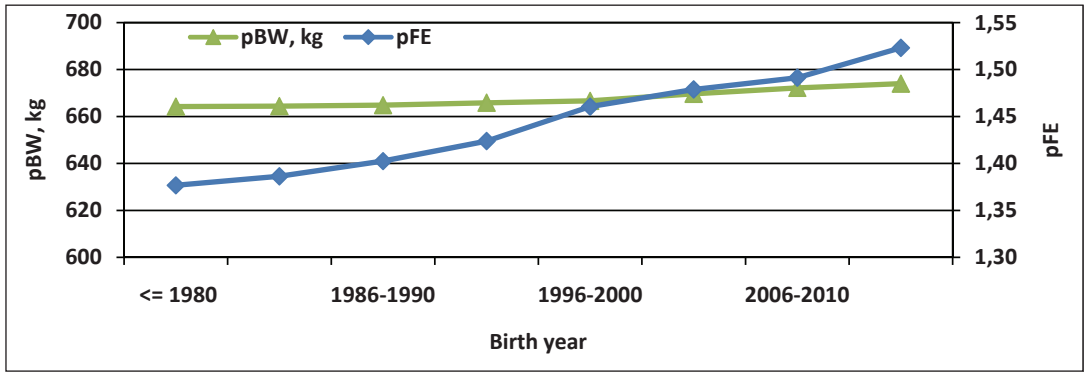

Figure 2. Trend of predicted body weight (pBW, kg) and predicted feed efficiency (pFE) for Holstein Friesian bulls evaluated in Italy (ANAFI, April 2015)

CONCLUSION

The results of this explorative study suggest that pFE can be successfully selected to enhance profitability of dairy cattle using current milk recording system. Recent advances in the dry matter intake at individual level using a roughage intake control system or similar tools seem to be very helpful to set up specific selection strategies for feed efficiency. A larger dataset with direct measurements on DMI should be considered to confirm results of the present study.

REFERENCES

1. Cassandro, M., Cecchinato, A., Battagin, M., Penasa, M. (2010): Genetic parameters of predicted methane production in Holstein Friesian cows. In: Proceedings of the 9th World Congress on Genetics Applied to Livestock Production, 1-6 August, Leipzig, Germany, p. 181.
2. Cassandro, M., Gallo, L., Carnier, P., Mantovani, R., Bittante, G. (1997): Un indicatore economico per la stima della redditività della vacca da latte. Bianco Nero, 36(2): 8-10.
3. Cassandro, M., Mele, M., Stefanon, B. (2013): Genetic aspects of enteric methane emission in livestock ruminants. Italian Journal of Animal Science, 12: e73. doi: http://dx.doi.org/10.4081/ijas.2013.2727
4. Chase, L.E., Sniffen, C.J. (1985): Equations used in "Anal-FEED" a VisiCal template. Mimeo, Cornell Univ., Dep. Anim. Sci., Ithaca, NY.
5. Connor, E.E., Hutchison, J.L., Norman, H.D., Olson, K.M., Van Tassell, C.P., Leith, J.M., Baldwin, R.L. (2013): Use of residual feed intake in Holsteins during early lactation shows potential to improve feed efficiency through genetic selection. Journal of Animal Science, 91: 3978–3988. doi: http://dx.doi.org/10.2527/jas2012-5977
6. De Haas, Y., Calus, M.P.L., Veerkamp, R.F., Wall, E., Coffey, M.P., Daetwyler, H.D., Hayes, B.J., Pryce, J.E. (2012). Improved accuracy of genomic prediction for dry matter intake of dairy cattle from combined European and Australian data sets. Journal of Dairy Science, 95: 6103-6112. doi: http://dx.doi.org/10.3168/jds.2011-5280
7. Hegarty, R.S., Goopy, J.P., Herd R.M., McCorkell, B. (2007): Cattle selected for lower residual feed intake have reduced daily methane production. Journal of Animal Science, 85: 1479–1486. doi: http://dx.doi.org/10.2527/jas.2006-236
8. Meuwissen, T.H.E., Hayes, B.J., Goddard, M.E. (2001): Prediction of total genetic value using genome-wide dense marker maps. Genetics, 157: 1819-1829.
9. Manzanilla Pech, C.I.V., Veerkamp, R.F., Calus, M.P.L., Zom, R., van Knegsel, A., Pryce, J.E., De Haas, Y. (2014): Genetic parameters across lactation for feed intake, fat- and protein-corrected milk, and live weight in first-parity Holstein cattle. Journal of Dairy Science, 97: 5851-5862. doi: http://dx.doi.org/10.3168/jds.2014-8165
10. Pryce, J.E., Wales, W.J., de Haas, Y., Veerkamp, R.F., Hayes, B.J. (2014): Genomic selection for feed efficiency in dairy cattle. Animal, 8: 1-10. doi: http://dx.doi.org/10.1017/S1751731113001687
11. Vallimont, J.E, Dechow, C.D, Daubert, J.M., Dekleva, M.W, Blum, J.W, Barlieb, C.M, Liu, W., Varga, G.A, Heinrichs, A.J, Baumrucker, C.R. (2011): Short communication: Heritability of gross feed efficiency and associations with yield, intake, residual intake, body weight, and body condition score in 11 commercial Pennsylvania tie stalls. Journal of Dairy Science, 94: 2108-2113. doi: http://dx.doi.org/10.3168/jds.2010-3888
12. Veerkamp, R.F., Oldenbroek, J.K., Van Der Gaast, H.J., Van Der Werf, J.H.J. (2000): Genetic correlation between days until start of luteal activity and milk yield, energy balance, and live weights. Journal of Dairy Science, 83: 577–583. doi: http://dx.doi.org/10.3168/jds.S0022-0302(00)74917-4
13. Verbyla, K.L., Calus, M.P.L., Mulder, H.A., de Haas, Y., Veerkamp, R.F. (2010): Predicting energy balance for dairy cows using high-density single nucleotide polymorphism information. Journal of Dairy Science, 93: 2757–2764. doi: http://dx.doi.org/10.3168/jds.2009-2928
14. Wall, E., Coffey, M.P., Brotherstone, S. (2007): The relationship between body energy traits and production and fitness traits in first-lactation dairy cows. Journal of Dairy Science, 90: 1527-1537. doi: http://dx.doi.org/10.3168/jds.S0022-0302(07)71638-7

(Received on 6 May 2015; accepted on 4 August 2015)