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COMMUNICATION

Genetic relationship between body condition score, fertility, type and production traits in Brown Swiss dairy cows

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ABSTRACT

This study aimed to investigate the relationship between body condition score (BCS), calving interval (CI), angularity (ANG), strength (FV) and milk yield (MY) on Brown Swiss cattle using data collected in the alpine provinces of Bolzano-Bozen and Trentino. The data set consisted of 28,538 test day records of BCS and MY from 3,282 Brown Swiss cows in lactation reared in 109 herds; production traits were merged with 13,796 repeated individual calving interval records and 38,711 type traits records. A multi-traits REML animal model was used to estimate (co)variance components, with repeated observations. Heritability estimates for BCS, FV and ANG was 18%, 18% and 27%, respectively, while estimates for CI was very low (2%). Genetic correlations between CI and BCS was -0.44; between BCS and ANG was -0.64; between BCS and MY was -0.35; between ANG and CI was 0.12. In conclusion, the selection for MY and ANG negatively affect fertility and average condition score of Brown cows. BCS recorded during lactation could be proposed as a useful trait for indirect selection aimed to improve fertility of cows.

Key words: Body condition score, Calving interval, Milk yield, Type traits.

Introduction

Genetic selection on production traits is reducing reproductive efficiency of dairy cattle (Castillo-Juarez et al., 2000), increasing susceptibility to some diseases and the risk of culling (Dematawewa and Berger, 1998). Hence, functional traits, and possibly also fertility traits, should be included as part of the breeding goal, but the possibilities of actually using reproductive information as a selection tool for breeders are limited. Calving interval (CI) is traditionally the main measure of reproduction during the productive life of the animal, particularly in dairy cattle (Rege and Famula, 1993) and it is more likely to be recorded accurately when compared to other fertility traits. However, CI might not be the most desirable measure of fertility to be included in a breeding goal, because CI data are available on fertile animals only, and not on culled cows. Moreover, CI is only available for multiparous cows, and so represents an inefficient trait for breeding companies, whose decisions on bulls are based on information available earlier in their bull’s daughters. Thus, traits possibly correlated with CI but available earlier than CI, such as BCS and some type traits, may be useful in selection of dairy cows.

Aim of this study was to estimate genetic parameters for BCS, CI, some type traits and milk yield using data recorded on Brown Swiss cows herded in the Bolzano-Bozen and Trentino provinces.

Material and methods

Data set consisted on test day records of production and functional traits collected by Superbrown consortium from September 2001 to


**Results and conclusions**

Descriptive statistics of traits are shown in Table 1. Average test day milk yield exceeded 26 kg/d. Average CI was close to 410 days, suggesting a decline of fertility in Brown Swiss cattle. Average BCS during lactation was equal to 3.21, ranged between 1.50 and 4.75 and exhibited a variation coefficient greater than 14%.

Table 2. Additive genetic variance ($\sigma^2g$), heritability ($h^2$), standard error (s.e.) of $h^2$, and genetic correlation for traits of concern (standard error of genetic correlation ranged from 0.075 to 0.187).

| Trait               | $\sigma^2g$ | $h^2$  | SE of $h^2$ | BCS    | CI    | ANG    |
|---------------------|-------------|--------|-------------|--------|-------|--------|
| BCS                 | 0.028       | 0.178  | 0.018       |        |       |        |
| Calving Interval (CI) | d 70.220  | 0.017  | 0.006       | -0.438 |       |        |
| Milk yield          | kg/d 2.901  | 0.105  | 0.013       | -0.345 | 0.152 |        |
| Angularity (ANG)    | 12.889      | 0.270  | 0.011       | -0.643 | 0.123 |        |
| Strength            | 9.203       | 0.184  | 0.010       | 0.302  | -0.236| 0.250  |

September 2004. BCS was collected monthly on all lactating cows. Type traits (angularity – ANG and strength – FV) were available only in primiparous cows and were extracted by data base of National Breeders Association of Brown Swiss (ANARB). The final data set consisted of 28,538 test day records of BCS and MY from 3,282 lactating Brown Swiss cows herded in 109 farms and of 13,796 individual CI records and 38,711 individual type traits. Genetic parameters were estimated using REML. Variance component estimation (VCE) package (Groeneveld, 1996) was used to estimate (co)variance components according to the following models:

\[
\begin{align*}
\text{BCS}_{ijklmn} &= \mu + \text{HTDi} + \text{age}_j + \text{cdib}_k + \text{clatl} + a_m + c_m + e_{ijklmn} \\
\text{MY}_{ijkmn} &= \mu + \text{HTDi} + \text{age}_j + \text{cdib}_k + a_m + c_m + e_{ijkmn} \\
\text{CI}_{ijklmn} &= \mu + \text{HYS}_i + \text{age}_j + \text{prod}_k + durl + a_m + c_m + e_{ijklmn} \\
\text{T}_{ijkmn} &= \mu + \text{HYS}_i + \text{age}_j + \text{ISPET}_k + a_m + e_{ijkmn}
\end{align*}
\]

where \( T = \text{ANG or FV}; \) \( \text{HTDi} = \) fixed effect of herd-test-day; \( \text{age}_j = \) fixed effect of age at calving within parity; \( \text{cdib}_k = \) fixed effect of days in lactation; \( \text{clatl} = \) fixed effect of milk production within parity; \( \text{HYS}_i = \) herd year season of calving; \( \text{prod}_k = \) fixed effect of milk yield within parity; \( \text{durl} = \) fixed effect of length of lactation; \( \text{ISPET}_k = \) fixed effect of inspector; \( a_m = \) random animal effect; \( c_m = \) permanent environmental random animal effect; and \( e_{ijklmn} = \) random residual effect. Variance and covariance components were estimated for MY, BCS, CI, ANG and FV. A pedigree data consisted on 92,436 animals. All animals had sire information and the large majority of cows had dam identifications as well. Pedigrees for as many of the dams and sires as possible were also included in the pedigree file.
Additive genetic variance, heritability and genetic correlations for traits of concern are shown in Table 2. BCS showed a moderate $h^2$ estimates (18%), although $h^2$ estimated in this study was lower than that found for BCS in Holstein cows by Gallo et al. (2001). As expected, CI showed a very low $h^2$ value (2%), and this is in agreement with results of previous studies on Holsteins (Pryce et al., 2001). Also type traits showed moderate $h^2$ estimates, ranging between 18 and 27 % for ANG and FV, respectively.

Genetic correlations between traits are shown in Table 2. BCS was negatively correlated with CI, MY and ANG but positively correlated with FV. Milk yield appeared positively correlated with CI. Therefore, a decrease of average condition score and an increase of CI are to be expected as indirect responses of selection for increase milk yield.

Also ANG was positively correlated with CI; therefore, more angular cows have longer CI. Conversely, BCS could be useful for predict an early and reliable fertility genetic index of bulls for their daughters' fertility because it is available since the first days of lactation.

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