

## Genetic Trends for Body Weight Traits in Dairy Cattle Population

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**Abstract:** The genetic trends for certain body weight traits in cows and calves on the basis of data base comprising information for over 100 years, gathered for the analysed farm was evaluated. The trend was increasing for the following traits: body weight at birth, body weight at 12 and 15 months and cow body weight after 1st, 2nd and 3rd calving. For dairy cattle both birth body weight and cow body weight, together with exterior traits should be considered as additional selection criteria for improvement.

**Key words:** Dairy cattle, genetic trend, body weight, birth body weight, cows

### INTRODUCTION

There is a opinion among breeders that the correlation between body weight and milk yield and between body weight and cow fertility is negative. This is proved by the results obtained, e.g. by Veerkamp (1998) and Veerkamp and Thompson (1999). Brotherstone *et al.* (2007) on the other hand, showed the negative correlation between weight at calving and reproduction ( $r = -0.61$ ).

Perez-Cabal *et al.* (2006) proved that as far as economic aspect is concerned, mature body weight has negative effect on overall production efficiency. The earlier research concerned both genetic trends and correlation between body weight of cows or calves and production traits over several decades. As Abdallah and McDaniel (2000) who investigated genetic trends concerning the period of 43 years in order to evaluate genetic gain in cattle precisely, one needs data covering over 20 years.

In the presented research the improved trait data cover over 100 years and the trend was also estimated for that period. That was done for easier result interpretation and for showing how much can be done by systematic and consistent breeding work.

The aim of the research was the analysis of the genetic gain for body weight traits which are rarely taken into account in the process of dairy cattle population improvement and which are at the same time very important for the breeding.

### MATERIALS AND METHODS

The research concerned black and white dairy cattle population kept and bred on one of Wielkopolska large farms. The analysed data covered the years 1905 to 2006.

The discussed population had been improved by using best black and white sires. Since, 1970-ties following the domestic breeding programme, the sires used have mainly been of black and white variety of Holstein-Frisian breed.

The analysed population comprised 6454 cows born to 709 sires and the breeding was based on family groups. The eldest family tree was 20 generation deep. All the data were found in breeding documents which were still kept on the farm. The material was divided into 92 classes of genetic groups according to the birth year. The first class (the least numerous) included cows born by 1912. The last one comprised cows born in 2003 and later.

In the study, researchers analysed genetic trends for body weight at birth for body weight at 6, 12 and 15 months of age for cow body weight (in kg) after 1st, 2nd and 3rd calving and for body weight of calves born in 1st, 2nd and 3rd parity. Based on the data used for evaluating the genetic gain in subsequent years the linear model below was created:

$$Y_{ijklmno} = \mu + s_i + d_j + g_k + h_l + f_m + w_n + e_{ijklmno}$$

Where:

- $Y_{ijklmno}$  = The phenotypic value observed for the trait
- $\mu$  = Population mean
- $s_i$  = Sire random effect
- $d_j$  = Dam random effect
- $g_k$  = The fixed effect of genetic group of individuals born in the same year
- $h_l$  = The fixed effect of herd year season (according to the production year)
- $f_m$  = The fixed effect of h-f genes proportion
- $w_n$  = The fixed effect of the first calving age
- $e_{ijklmno}$  = Random error

Researchers used DFREML statistical package for the calculation. On the basis of estimated values of genetic group effect researchers drew the regression lines for that effect in time in order to illustrate the genetic trend for analysed traits.

**RESULTS**

Genetic and phenotypic trends for the following: body weight at birth and body weight at 6, 12 and 18 months of age has been presented on (Fig. 1-5). The value (as regression coefficient) of genetic trend for other traits ranged from 0.421-0.699.

Genetic trends and phenotypic values for cow body weight at calving are presented on (Fig. 6-8)

and they are rising slowly but steadily. That might be explaining the increasing trend for calf body weight at birth.

For better understanding of the rising genetic trend for calf body weight we conducted similar calculation for overall material divided into groups depending on the subsequent lactation of a cow. That was the way to eliminate the effect of body weight of a calving cow and of her somatic development on different body weight values for newborn calves.

On Fig. 9-11, researchers present increasing genetic trends for body weight of calves born to cows in subsequent lactations. The estimated regression coefficients were very similar and they ranged from 0.103-0.115.

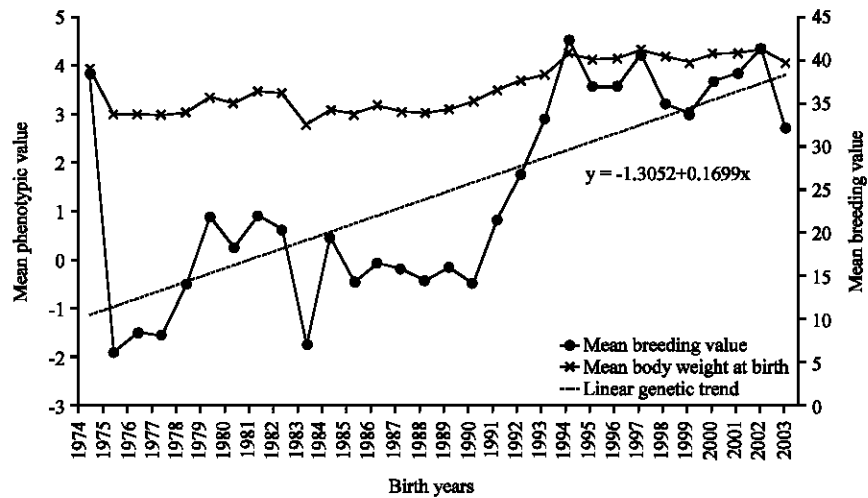


Fig. 1: Genetic and phenotypic trend for mean body weight at birth (kg)

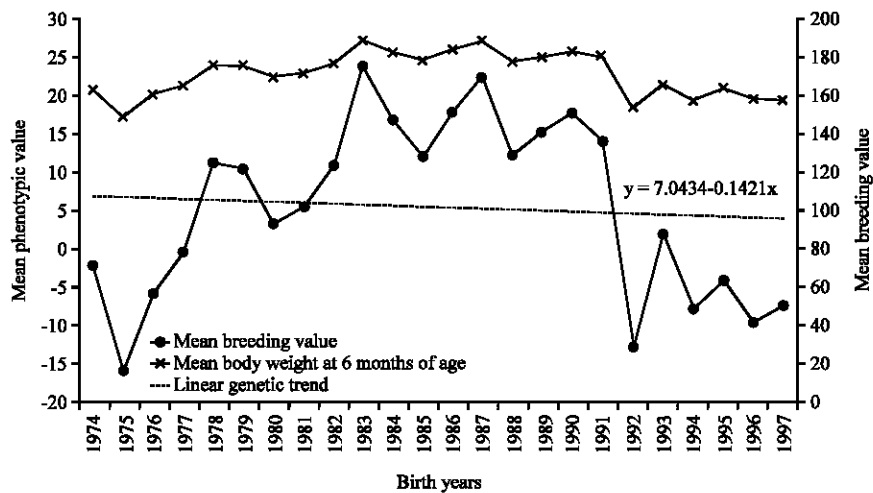


Fig. 2: Genetic and phenotypic trend for mean body weight at 6 months of age (kg)

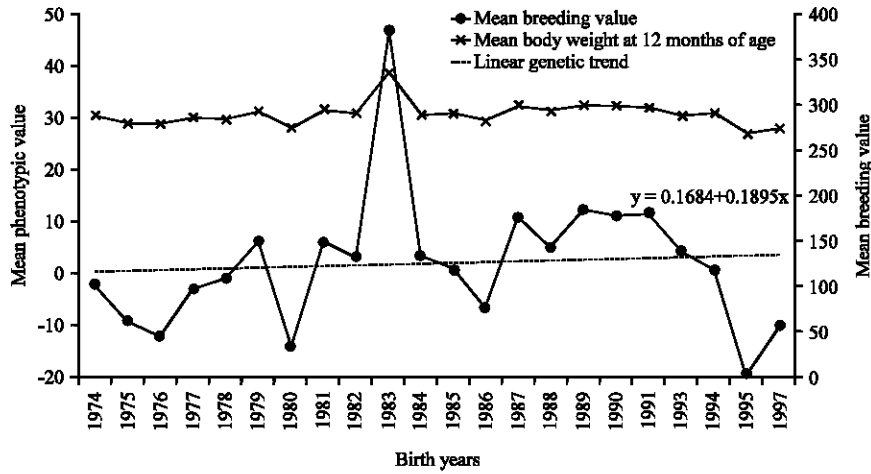


Fig. 3: Genetic and phenotypic trend for mean body weight at 12 months of age (kg)

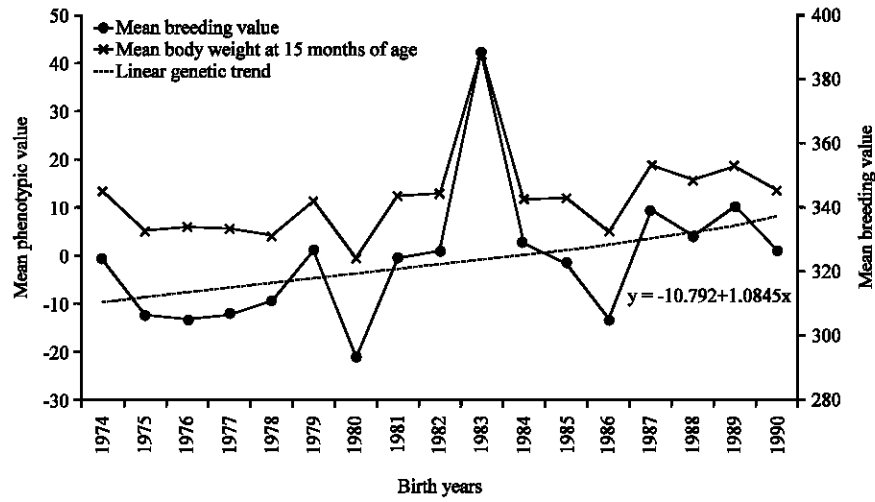


Fig. 4: Genetic and phenotypic trend for mean body weight at 15 months of age (kg)

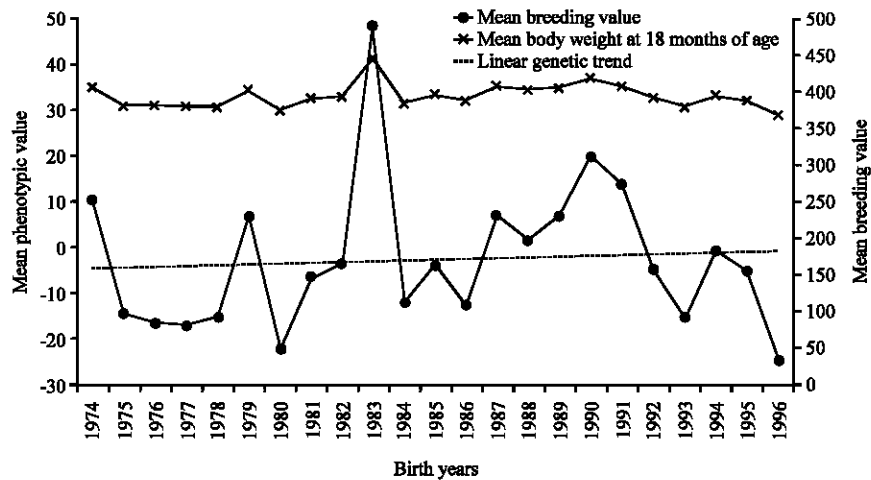


Fig. 5: Genetic and phenotypic trend for mean body weight at 18 months of age (kg)

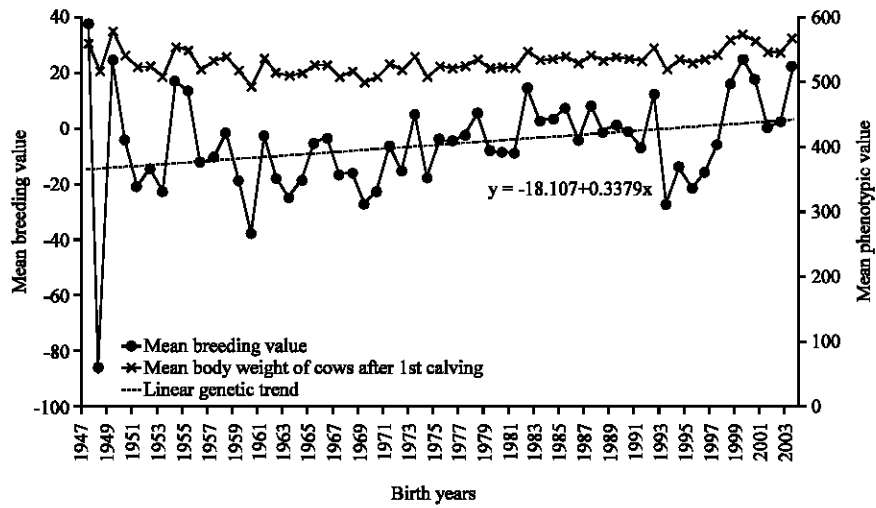


Fig. 6: Genetic and phenotypic trends for mean body weight (kg) of cows after 1st calving

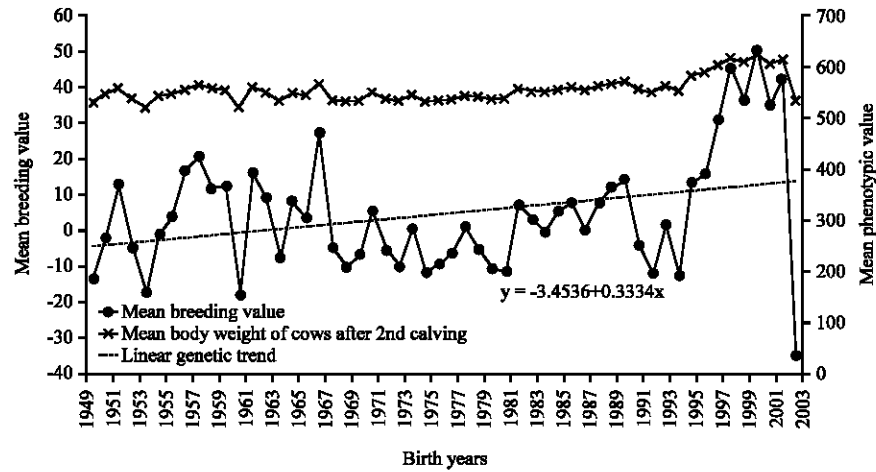


Fig. 7: Genetic and phenotypic trends for mean body weight (kg) of cows after 2nd calving

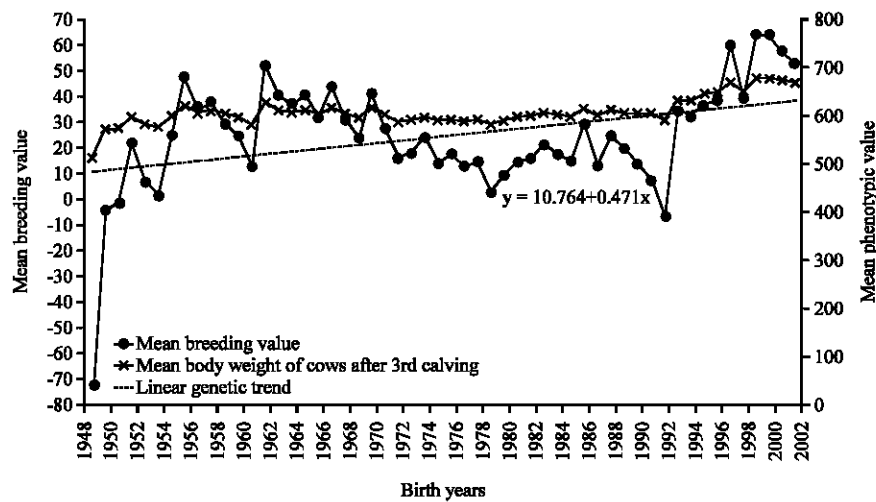


Fig. 8: Genetic and phenotypic trends for mean body weight (kg) of cows after 3rd calving

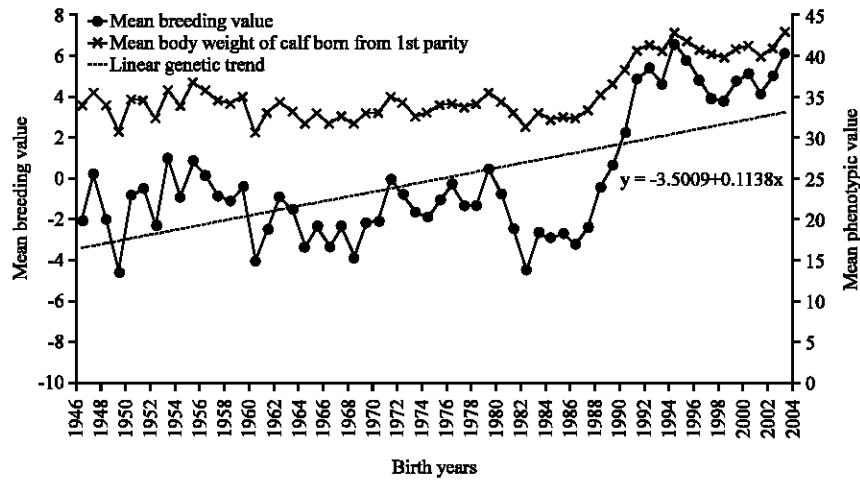


Fig. 9: Genetic and phenotypic trend for mean body weight (kg) of calf born from 1st parity

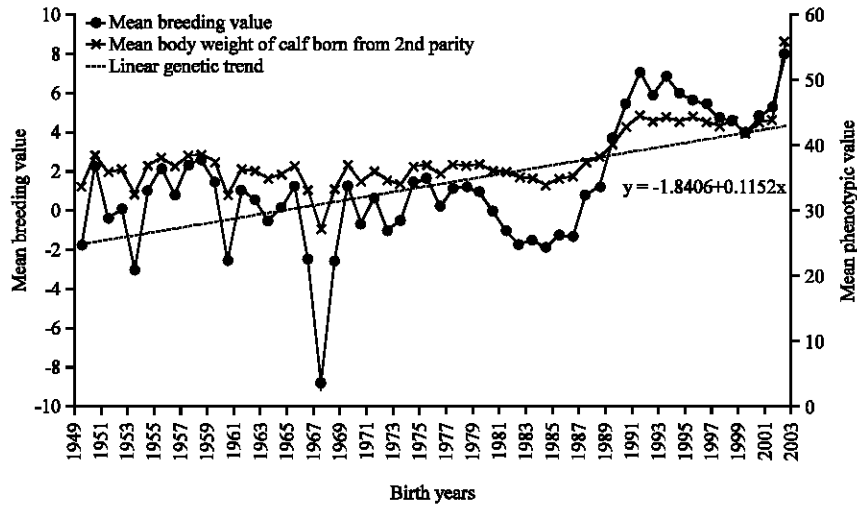


Fig. 10: Genetic and phenotypic trend for mean body weight (kg) of calf born from 2nd parity

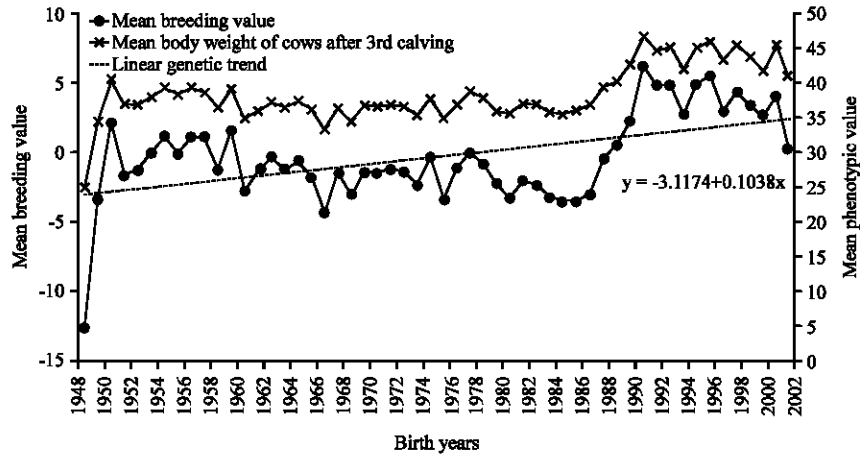


Fig. 11: Genetic and phenotypic trend for mean body weight (kg) of calf born from 3rd parity

## DISCUSSION

Rygallo and Trela (2002) also analysed body weight of heifers and examining a group of 1997 born individuals they estimated mean birth body weight to be lower than estimated by us in the present research. On the other hand for 6 and 12 months old individuals the means were higher. For 15 and 18 months old cattle the body weight values were comparable to those estimated in the research, however, Rygallo and Trela (2002) reported that mean body weight of cows after 1st calving was higher.

In one of the earliest handbooks on cattle breeding in Poland (Adametz, 1925) mentions that mean body weight of cow is about 550 kg. That value corresponds to the value researchers estimated from the data covering the corresponding period. Puchajda and Czaplicka (1994) analysed mean body weight of cows after first three calvings and the values they estimated were slightly lower than those estimated in the research. Grabowski (1975) analysed body weight of cows after third lactation and on average he also obtained results that corresponded to the estimation.

Zieminski *et al.* (1999) proved that for heifers with higher HF upgrading the increase in body weight both at 6 and 12 months of age and after first calving. Sakowski and Dymnicki (1994) reported lower body weight values for cows at 6, 12, 15 and 18 months of age and so did Gulinski *et al.* (1997) for the cows in 1st, 2nd and 3rd lactation. Moore *et al.* (1991) estimated mean body weight for first-parity cows to be similar to the values found in the research.

Abdallah and McDaniel (2000) obtained positive genetic trend for body weight of 1st parity cows born in 1950 to 1970 and 1980 to 1990 and the negative one for the cows born in 1970 to 1980. In the population researchers analysed on the other hand, the trend had been positive throughout the analysed period. Increasing genetic trends for body weight of cows at 1st calving and also for calves at 6 and 18 months of age were estimated by Plasse *et al.* (2002).

According to Dymarskiego *et al.* (2001) very sharp increase of genetic trend after 1990 might be caused by introducing embryo transfer technique as since that moment body weight of newborn calves has been reported to be much higher.

## CONCLUSION

In the analysed material as well as in the populations studied by other researchers the estimated genetic trend was positive for body weight at birth and for body weight

at 12, 15 and 18 months of age and it was negative for body weight at 6 months of age. Similarly, for cows after 1st, 2nd and 3rd calving the trend for body weight was also positive. This corresponds to breeder's expectations that larger cows should produce larger calves.

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