Statistical Indicators

E-21

Breeding Value Weight

▪ Introduction

Within the Dutch dairy cow population there are large genetic differences regarding the body weight (BW) of dairy cows. Since August 2001 a breeding value for BW is published, to support farmers who want to take these differences into account when deciding on their selection.

▪ Data

Because large scale collection of direct information (weightings) is practically not feasible, conformation data are used as predictors for the breeding value BW. These predictors are stature, chest width, body capacity, body condition score and rump width and they are used because the genetic predisposition correlates clearly with BW (Table 1). High breeding values for stature, chest width, body capacity, body condition score and rump width are expected to correlate on average with a high breeding value for weight.

Table 1. Description of the conformation traits stature, chest width, body capacity, body condition score, rump width and the genetic correlation with body weight

	scale	genetic correlation
stature	cm	0.50[1]
chest width	1 – 9 (narrow – wide)	0.79[2]
body capacity	1 – 9 (little – much)	0.48[1]
body condition score	1 – 9 (little – much)	0.67[2]
rump width	1 – 9 (narrow – wide)	0.43[1]

[1] Koenen and Groen, 1998.

[2] Veerkamp and Brotherstone, 1997.

▪ Calculation breeding value BW

The breeding value BW is based on a linear combination of the available breeding values for the conformation traits that have a high genetic correlation with weight (Table 1). The weighting factor of the breeding values for the predictors is deduced through selection index theory which does not use the phenotypic correlations. The extent to which a conformation breeding value defines the breeding value for BW depends mainly on (1) the genetic correlation with BW and (2) the reliability of the estimated breeding value for the conformation trait and (3) the genetic correlations between the predictors themselves. Table 2 shows an overview of the used correlations between the predictors themselves.

Table 2. Genetic correlations between the predictors stature, chest width, body capacity, body condition score and rump width

	st	cw	bc	cs	rw
stature (st)	-	0.21[1]	0.28[1]	0.09[1]	0.43[1]
chest width (cw)		-	0.56[1]	0.67[1]	0.23[1]
body capacity (bc)			-	0.08[1]	0.30[1]
body condition score (cs)				-	0.09[1]
rump width (rw)					-

[1] Based on sire model with data from 280,150 Black & White heifers, classified between 1st of September 1996 and 15th of January 2000. NRS, not published.
[1] Based on sire model with data from 61,605 Black & White heifers, classified between 1st of October 1998 and 1st of July 2000. NRS, not published.

For breeding bulls with a conformation breeding value for stature (ST), chest width (CW), body capacity (BC), body condition score (CS) and rump width (RW) that is almost 100% reliable, the breeding value for weight (BV_{BW}) can be calculated as follows:

$$BV_{BW} = 100 + 0.29 \text{ X } (BV_{ST} - 100) + 0.40 \text{ X } (BV_{CW} - 100) + 0.10 \text{ X } (BV_{BC} - 100) + 0.36 \text{ X } (BV_{CS} - 100) + 0.15 \text{ X } (BV_{RW} - 100)$$

However, because the weighting factor of the conformation breeding values depends on the reliability of the predictors, the weighting factor may differ per bull.

▪ Publication

The breeding value for BW is published as a relative breeding value (light - heavy) with an average of 100 and a standard deviation of 4.5 (in the case of 100% reliability) A breeding value of more than 100 means that the BW of a heifer is heavier than the average. When the breeding value is below 100, the heifer is expected to be lighter than the average.

The meaning of the standard deviation
The standard deviation of 4.5 points in the published breeding values correlates with the genetic standard deviation in BW of 29.6 (Koenen and Groen, 1998), which means that one breeding value point means a difference of 6.33 kg. A sire can only pass on half of its breeding value to its daughters. This means that a sire with a breeding value of 104 has daughters that are on average almost 13 kg heavier than the daughters of a sire with a breeding value of 100.

Publication condition
The breeding value BW is published for AI sires if the breeding value has a reliability of 25% or more and the underlying conformation traits meet the conformation requirements.

▪ Base

Breeding values for body weight are published based on the 2015-base. Cows born in 2010 determine the base of 2015. There are four different bases: Milk goal Black, Milk goal Red, Dual purpose and Belgian Blue. The definitions of these bases are as follows:

Milk goal Black (Z)

Herdbook-registered cows born in 2010 with at least 87.5% HF-blood and up to 12.5% FH-blood and hair colour black pied, with at least one observation in the genetic evaluation.

Milk goal Red (R)
Herdbook-registered cows born in 2010 with at least 87.5% HF-blood and up to 12.5% MRY-blood and hair colour red pied, with at least one observation in the genetic evaluation.

Dual purpose (D)
Herdbook-registered cows born in 2010 with at least 75% MRIJ-blood and 25% or less HF blood, with at least one observation in the genetic evaluation.

Belgian Blue (B)
The base Belgian Blue is determined by the cows that determine the Dual purpose base.

An observation is defined as a score for conformation collected during the herd classification.

Every 5 years, in a year dividable by 5, the reference year for the base is moved 5 years.

The cows from the Milk goal Black base are used to determine the standard deviation of the breeding values for all bases. The standard deviation of the breeding values from the base animals is calculated followed by standardisation of this standard deviation to an average reliability of 80% for the breeding values. Because of this 4 points breeding value corresponds to 0.9 x genetic standard deviation of the concerning trait. Using one standard deviation for the 4 bases has as advantage that only the level differs between the bases and no difference exists between the standard deviations. Table 2 shows the base differences for BW.

Tabel 3. Basis differences for Body Weight

Trait	Kind of base(1)	Base differences(2)					
		Z=>R	**Z=>D**	**Z=>B**	**R=>D**	**R=>B**	**D=>B**
Body weight	C	0	-3	-3	-3	-3	0

(1) C=cow base, S=sire base
(2) Z= Milk goal Black, R= Milk goal Red, D= Dual purpose, B= Belgian Blue

▪ Reliability

The reliability of the breeding value BW depends on the reliability of the individual predictors. For a bull with proofs of 60 daughters with type-classifications the reliability is almost 70%, for a breeding bull with an extreme amount of daughters it is around 80%. The maximum reliability will be lower than 100%, even in a situation with very many daughters, because this method is an indirect way of breeding value estimation.

▪ Literature

Koenen, E.P.C. and A.F. Groen, 1998. Genetic evaluation of body weight of lactating Holstein heifers using body measurements and conformation traits. *J. Dairy Sci.* 81: 1709-1713.

Veerkamp, R.F. and S. Brotherstone, 1997. Genetic correlations between linear type traits, food intake, live weight and condition score in Holstein Friesian dairy cattle. *Anim. Sci.* 64: 385-392.