

Index numbers

E-40

Breeding value dry matter intake

▪ **Introduction**

Dairy cows use feed to produce milk, for maintenance and to grow. The amount of feed taken in by a cow depends on the amount of milk produced, composition of the milk, as well as the body weight and growth. Breeding values for milk production traits have been used for years in the selection of animals. Breeding values for body weight are also known, using a number of conformation traits (E-Chapter 21).

Milk production and body weight can be used to calculate how much feed a cow needs by using the genetic correlations. But it is also possible to measure the amount of feed taken in. From this dry matter intake, a breeding value can be calculated. The breeding value based on these two sources may then serve to determine to what extent an animal uses the feed efficiently, i.e. how much milk the animal will produce from this.

This chapter provides further information about the breeding value estimation for dry matter intake.

▪ **Data**

For the breeding value estimation, use is made of dry matter intake data from Holstein-Friesian cows that have calved since 1990. These are data of cows that were part of research and were collected on a number of dairy farms in the Netherlands. In 2015, the analysis was performed on about 3000 cows with weekly measurements for dry matter intake, between 2 and 50 weeks per lactation. The dry matter intake trait is measured in kilograms of dry matter.

In addition, in the breeding estimation, data are used from a number of predictors, being daily milk, fat and protein productions as well as weight.

A cow is included in the breeding value estimation when she is herdbook registered, meaning that her pedigree is recognised.

▪ **Statistical model**

Calculation of breeding values for dry matter intake is done using an animal model, according to the BLUP technique (Best Linear Unbiased Prediction). For the breeding value estimation, the genotypes of the animals are used as well, allowing a better determination of the relationships between the animals. The breeding values from the estimation are the result of observations, pedigree information and genotype information from the cow or, if the cow does not have a genotype, the genotype of the cow's sire combined with dry matter intake information. The data have also been used to estimate the genetic correlations between the dry matter intake traits, milk production traits and weight. This means the breeding values for milk production traits and weight are also included in the breeding value for dry matter intake.

In the calculation of breeding values for dry matter intake the following statistical model, based on research by Veerkamp (2014), is used:

$$y = \text{EXP} + \text{HM} + \text{HY} + \text{AGE} + \text{LACTST} + \text{BREED} + \text{PERM} + \text{A} + \text{Resid}$$

where:

y	:	Observation of animal;
EXP	:	Experiment, a combination of farm and management/experiment effect;
HM	:	Herd*Month of the measurement;
HY	:	Herd*Year of calving;
AGE	:	Age at calving;
LACTST	:	Lactation stage;
BREED	:	Breed percentage of the most important breed;
PERM	:	Permanent environment of animal;
A	:	Breeding value of animal;
Resid	:	Residual term of y which is not explained by the model.

▪ Parameters

Table 1 shows the heritability for dry matter intake per trait as well as the genetic standard deviation per trait. Table 2 shows the genetic correlations.

Table 1. Heritability (h^2) and genetic standard deviation (kg/day) for dry matter intake.

Trait	h^2	genetic standard deviation
Lactation 1	0.28	1.24
Lactation 2	0.25	1.39
Lactation 3+	0.20	1.51

Table 2. Genetic correlations between dry matter intake and indicator traits.

	Dry matter intake lactation 1	Dry matter intake lactation 2	Dry matter intake lactation 3+	Kg milk	Kg fat	Kg protein	Body weight
Dry matter intake lactation 1							
Dry matter intake lactation 2	0.88						
Dry matter intake lactation 3+	0.80	0.89					
Kg milk	0.55	0.58	0.56				
Kg fat	0.58	0.60	0.58	0.50			
Kg protein	0.59	0.61	0.59	0.91	0.65		
Body weight	0.67	0.45	0.41	0.10	0.10	0.10	

▪ Dry matter intake index

Indexes for dry matter intake in lactations 1, 2 and 3+ are calculated based on the breeding value for dry matter intake directly from the breeding value estimation for dry matter intake and breeding values for indicator traits from the breeding value estimation of the whole population.

If an animal has no breeding value for dry matter intake directly from the breeding value estimation for dry matter intake, the breeding value for dry matter intake is determined completely by the four indicator traits. The breeding values for dry matter intake for lactations 1, 2 and 3+ are combined in the dry matter intake index.

The dry matter intake index is a breeding value for dry matter intake across all lactations and is similar to, for example, the breeding value for milk production, where the breeding values for milk for the first three lactations have been combined into one breeding value as well.

The dry matter intake index is calculated as follows:

$$\begin{aligned} \text{Dry matter intake index} = & 0.41 \times \text{index for lactation 1} \\ & + 0.33 \times \text{index for lactation 2} \\ & + 0.26 \times \text{index for lactation 3+} \end{aligned}$$

▪ Presentation

Breeding values for dry matter intake are shown in kg of dry matter with respect to zero. Breeding values are shown to 2 decimal places.

The dry matter intake index is calculated for all animals of a dairy breed or dual-purpose breed. Basic differences between milk goal black, milk goal red and dual-purpose are shown in Table 3. Bulls with a daughter-based breeding value for indicator traits have a reliability for the dry matter intake index of about 60 percent.

When a bull has no daughters in milk yet, but does have a genomic breeding value for dry matter intake, the reliability is about 20 percent. Combining the genomic breeding value for dry matter intake with the breeding values for indicator traits increases the reliability of the breeding value for dry matter intake to about 53 percent.

Table 3. Basic differences for dry matter intake (kg), Z=milk goal black, R=milk goal red, D=dual purpose.

	Z→R	Z->D	R->D
Dry matter intake lactation 1	-0.35	-2.31	-1.96
Dry matter intake lactation 2	-0.43	-2.60	-2.13
Dry matter intake lactation 3+	-0.46	-2.72	-2.26
Dry matter intake total	-0.40	-2.51	-2.11

▪ Literature

R.F. Veerkamp, M.P.L. Calus, G. de Jong, R. van der Linde, Y. De Haas. Breeding Value for Dry Matter Intake for Dutch Bulls based on DGV for DMI and BV for Predictors. Proceedings 10th World Congress of Genetics Applied to Livestock Production, Vancouver, 2014.