Statistical Indicators

E-25

Breeding Value Urea

▪ Introduction

On January 1st, 2006 the new manure policy, with stricter standards, has come into effect. This new policy became necessary because the European Court decided that the old policy (Minas – the Dutch mineral registration system) did not have the desired effect with regard to the European Nitrates Directive. Also, specific limits have been set to the total amount of livestock manure, nitrogen and phosphate a farm can apply to the land on average per hectare, the so-called use standards. Every year, the amount of fertilizer used on a farm has to be accounted for by registering the farm's production, supply and discharge of fertilizers and calculating the yearly use. With dairy cows, the milk urea content is used for this purpose.

The average nitrogen excretion of dairy cows is estimated from the average milk production and the average urea tank level:

$N_{excretioncow}$	= 114.6 + 0.008 x (M – 7500) + 1.5 x (U – 26), in which
$N_{excretioncow}$	: amount of nitrogen in the manure cellar per cow per year (kg)
M	: average milk production (kg)
U	: average urea tank level (mg/100g)

Expectations are that a large majority of the dairy farms will have a manure surplus. For those farms, it will be interesting to reduce the average urea tank level. A reduction of 1 mg/100g, e.g. from 26 to 25 mg/100g, will reduce the fixed nitrogen excretion with 1.5 kg nitrogen per cow per year, which corresponds to (1.5 / 4.5 =) 0.333 tons of manure per cow per year. For a farm with 70 dairy cows, this makes a difference of (70 x 0.333=) 23.3 tons of manure.
A production increase of 7500 kg to 8500 kg milk per cow per year will increase the nitrogen excretion from 114.6 to 122.6 kg nitrogen per cow per year, assuming a urea tank level of 26. However, the farm will need fewer cows to fill quota. Therefore, a farm should reduce the nitrogen excretion per kg milk, not the nitrogen excretion per cow. In this example: 114.6 / 7500 = 0.01528 kg nitrogen per kg milk and 122.6 / 8500 = 0.01442 kg nitrogen per kg milk. For a milk quota of 500,000 kg milk this means a difference of 500,000 x (0.01528 – 0.01442) = 428 kg nitrogen per year. This corresponds to 428 / 4.5 = 95.2 tons of manure.

Reducing the urea content in the milk or increasing the production per cow, can reduce the total nitrogen excretion on a farm. The urea content in the milk can be influenced by breeding. Its heritability is high and the genetic spread is big. The genetic correlation with milk, fat, protein and other traits is zero. Therefore the decision had been made to provide breeding values for urea for bulls as of February 2007.

▪ Data for the Breeding Value Urea

Since 2001 it is possible to measure the urea content in milk optionally via MPR (Milk Production Registration). Urea is represented in milligrams per 100 grams of milk. This data is entered in the breeding value estimation for urea, calculated by the test-day model. Therefore, the applied data consists of urea data based on daily production (test-days). Data suppliers and data requirements

Figure 1 represents the change in the urea content of the milk, for every day in every lactation. Between lactations there is a negligible difference in daily urea content.

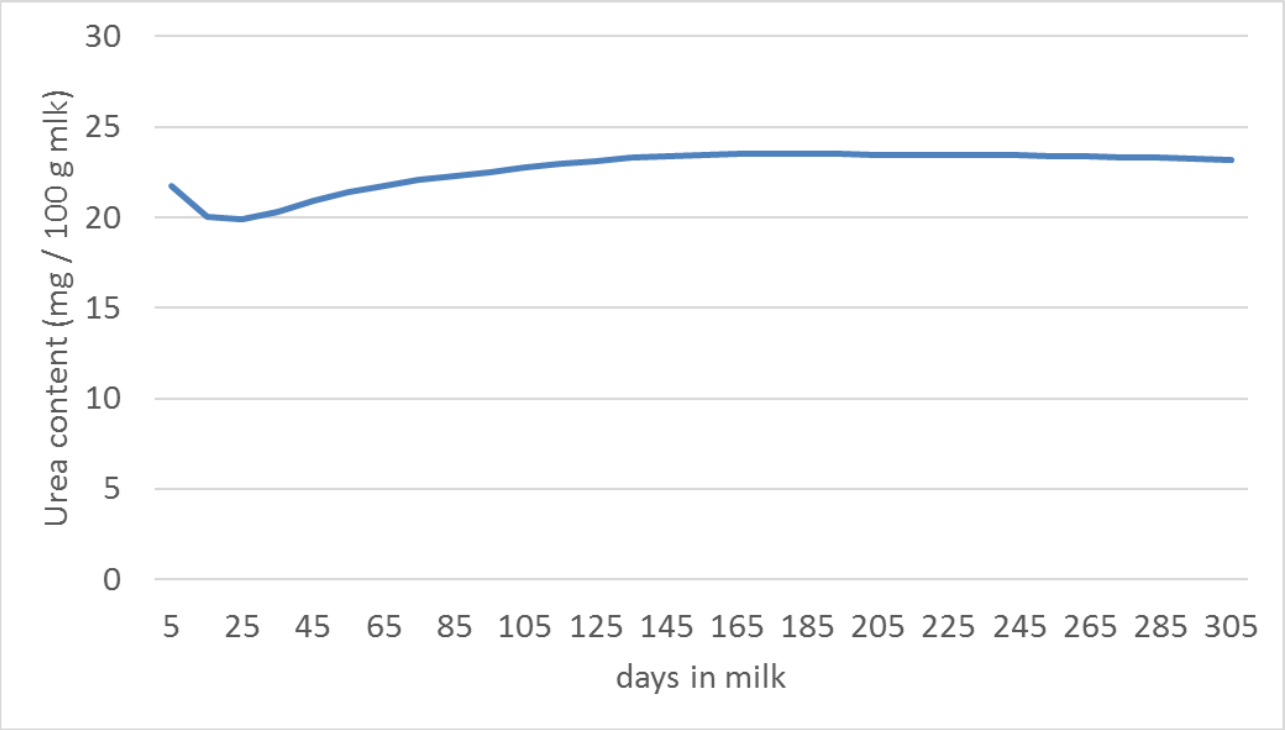

Figure 1. *Average urea per day in lactation 1 to 5*

have to meet the same requirements as in the breeding value estimation for production traits, see chapter E-7 of the Manual Quality. The only difference is that it is not necessary to know the amount of milk; daily productions without the amount of milk, but with urea will be used for the breeding value urea.

▪ Statistical model

The urea breeding value estimation is done with the test-day model, described in chapter E-7 of the Manual Quality. To estimate urea, the same fixed effects and random regression effects are used as for the estimation of milk production traits. Also heterogeneity of variance is corrected in the same way as is done for the milk production traits.

With the test-day model for milk production traits, breeding values for every animal are estimated for daily production on every day, from day 5 up to and including day 420 in lactation 1 to 5. In the same way, the test-day model for urea gives breeding values for every day, from day 5 up to and including day 420 in lactation 1 to 5. So every animal has its own genetic curve in lactation 1 to 5.

The genetic spreads on day level are in Figure 2, together with the spreads of the permanent environment, the farm curves and the remainder (the non-explained part of the urea measurement). The urea heritabilities on day level are in Figure 3 and are on average 0.27 and within lactation 0.27, 0.28, 0,29 for lactations 1, 2 and 3 and 0.30 for lactations 4 and 5, respectively.

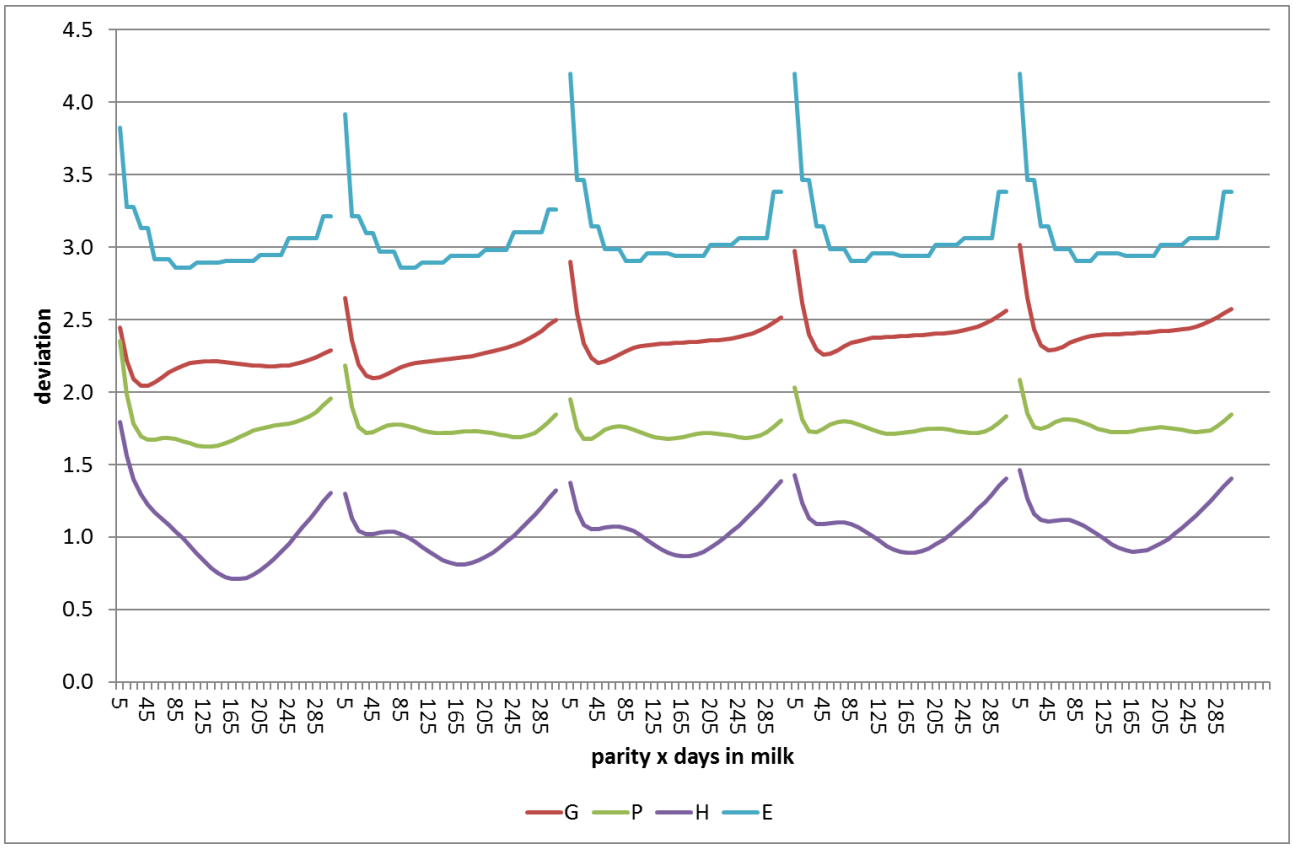

Figure 2. *Genetic (G), permanent environment (P), herd curve (H) and remainder (R) standard deviations for urea on day level for lactation 1 to 5*

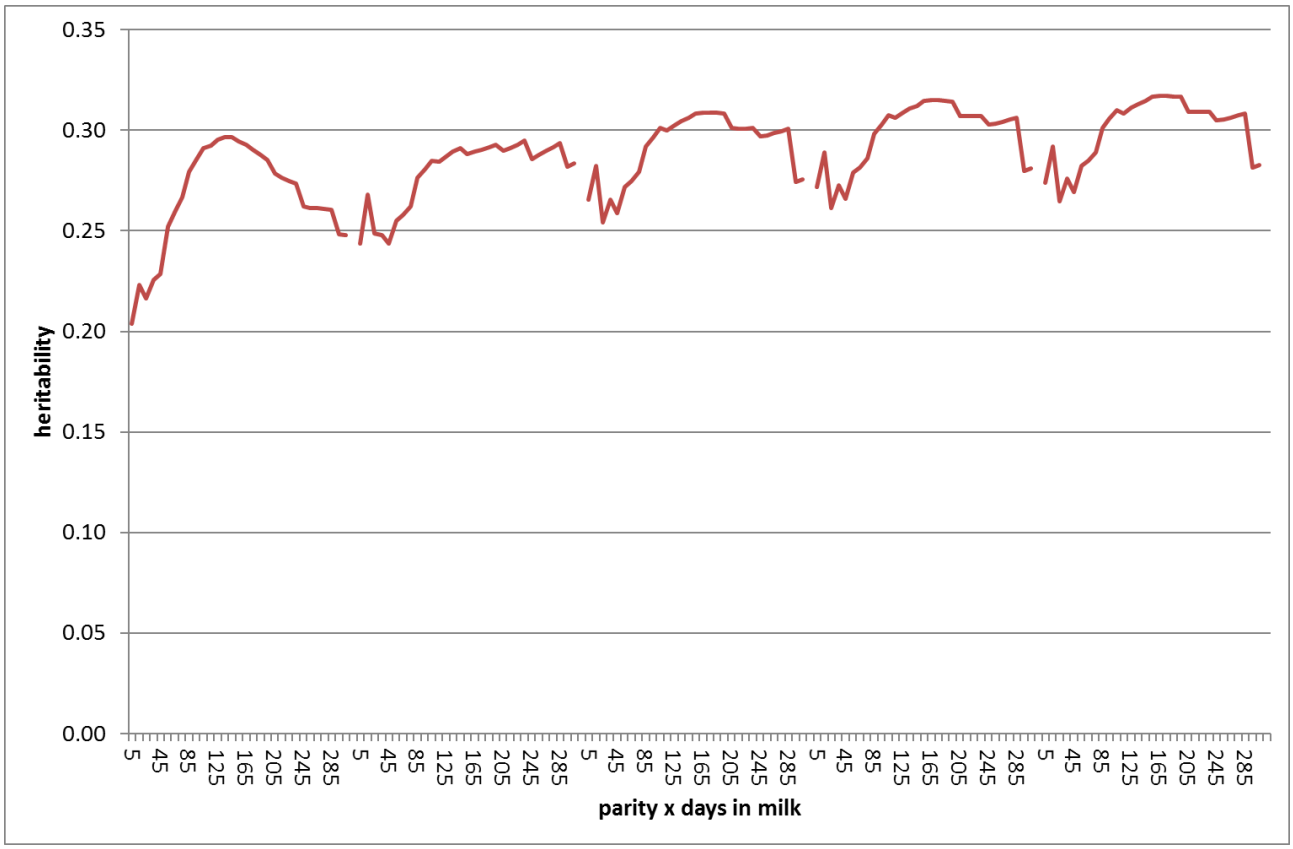

Figure 3. *Heritabilities for urea on day level for lactation 1 to 5*

Table 1. Genetic standard deviation, heritability (**bold**) en genetic correlations for milk urea.

	Genet. Std.dev.	Lactation 1	Lactation 2	Lactation 3	Lactatie 4	Lactatiom 5	Overall
Lactation 1	2.06	**0.64**					
Lactation 2	2.12	0.95	**0.64**				
Lactation 3	2.19	0.91	0.96	**0.65**			
Lactation 4	2.24	0.90	0.94	0.98	**0.65**		
Lactation 5	2.25	0.88	0.92	0.97	0.98	**0.65**	
Overall	2.09	0.97	0.99	0.98	0.97	0.96	**0.70**

The breeding values for urea on day level will not be published. However, from these day level breeding values 305-days breeding values are calculated by adding up the day level breeding values from day 5 up to and including day 305. Then the breeding values for lactation 1 to 5 are combined into a total breeding value for 305-days urea in the same way as is done for the milk production traits, e.g.

$$BV_{overalll} = 0{,}32 \times BV_1 + 0{,}25 \times BV_2 + 0{,}20 \times BV_3 + 0{,}14 \times BV_4 + 0{,}09 \times BV_5$$

Other derived traits, such as persistence and late maturity for production traits, are not calculated for urea.

Heritabilities for 305-days urea for lactation 1 to 5 and overall are given in Table 1, as well as the 305 day genetic standard deviation.

▪ Publication

The breeding values for urea are presented with an average of 0.0 and in units of milligrams per 100 grams of milk. The genetic spread of the breeding value for urea is 2.1 mg/100g milk. A breeding value under 0 means that daughters of this bull on average have a lower urea content in their milk. The bull passes on half of its breeding values to its daughters. A bull with a breeding value for urea of –6.0, will sire daughters that will have a urea content in their milk of on average 3.0 points lower.

Breeding values for urea are only published for AI sires if the reliability is 35% or more.

▪ Base

Breeding values for urea 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.

Table 2. Base differences for urea

	Z → R	*Z → D*	*Z → B*	*R → D*	*R → B*	*D → B*
Urea	-0.2	-0.6	-0.6	-0.4	-0.4	0
Urea, lactation 1	-0.2	-0.7	-0.7	-0.4	-0.4	0
Urea, lactation 2	-0.2	-0.7	-0.7	-0.4	-0.4	0
Urea, lactation 3	-0.2	-0.6	-0.6	-0.3	-0.3	0
Urea, lactation 4	-0.2	-0.6	-0.6	-0.3	-0.3	0
Urea, lactation 5	-0.2	-0.6	-0.7	-0.5	-0.5	0

Belgian Blue (B)
Herdbook-registered cows born in 2010 with at least 87.5% Belgian Blue-blood, with at least one observation in the genetic evaluation.

An observation is defined as a testday for urea. Every 5 years, in a year divisible by 5, the reference year for the base is moved 5 years. Table 2 shows the base differences for urea.

▪ Background Information

There are differences between breeds. They are reflected in Figure 4, presented on the Black&White base. In this figure you will find the average breeding values for cows of seven breeds. Brown Swiss cows clearly have a higher breeding value for urea than animals of the other breeds. On average, their breeding value is almost 5 points higher. Also Montbéliarde and MRIJ have higher breeding values for urea, on average well over one point and almost two points, respectively.

The correlation between urea and other traits is zero or almost zero. Therefore it is likely that there is no trend over the years for the breeding value for urea. After all, since there is no correlation with other traits, there has never been made an indirect selection for urea. In Table 3 is shown that this is indeed the case for bulls which are published on the Black & White base. The reliability is higher in the more recent years. This is due to the fact that more dairy farmers order a measurement of the urea content in their milk. Therefore, the younger testing bulls have more daughters with observations.

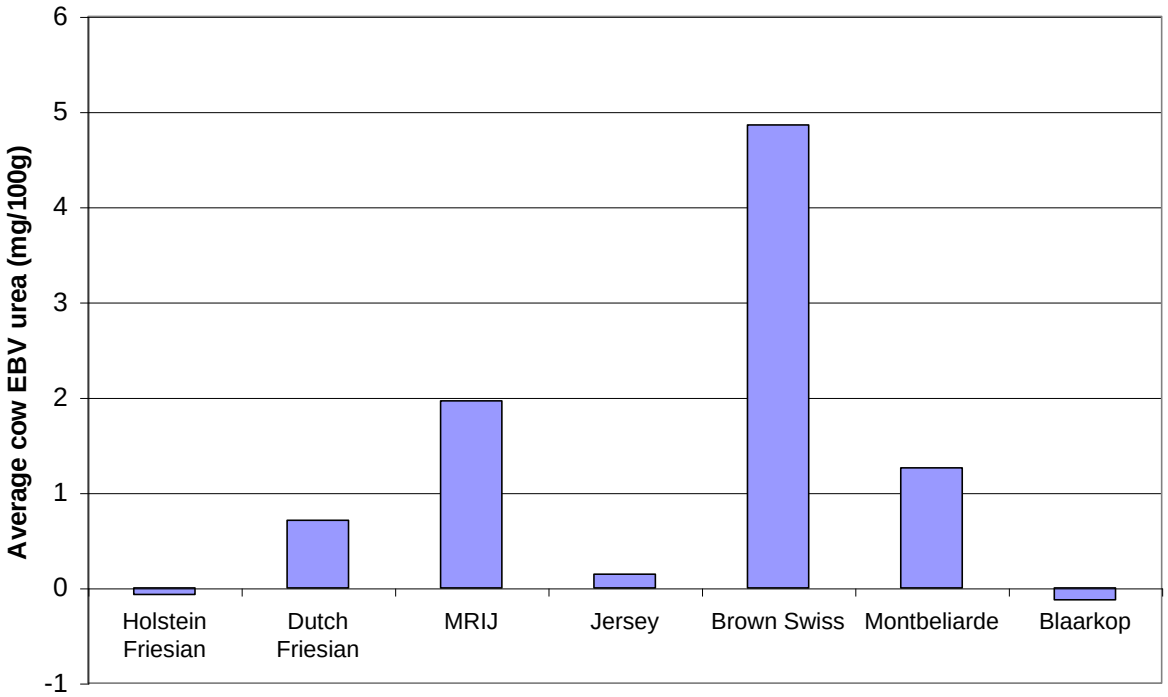

Figure 4. *Average cow breeding value for urea for seven breeds.*

Table 3. Average breeding value for urea and average reliability of the breeding value urea for bulls, per year of birth, published on Black & White base.

year of birth	average breeding value	reliability
2005	1.76	94%
2006	4.68	95%
2007	-0.11	95%
2008	2.13	96%
2009	4.86	94%
2010	0.72	93%
2010	5.55	88%