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:

Nexcretioncow	= 114.6 + 0.008 x (M – 7500) + 1.5 x (U – 26), in which
Nexcretioncow	: 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 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

have to meet the same requirements as in the breeding value estimation for production traits, see chapter E-7 of the CRV Handbook. 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.

Figure 1 represents the change in the urea content of the milk, for every day in every lactation.

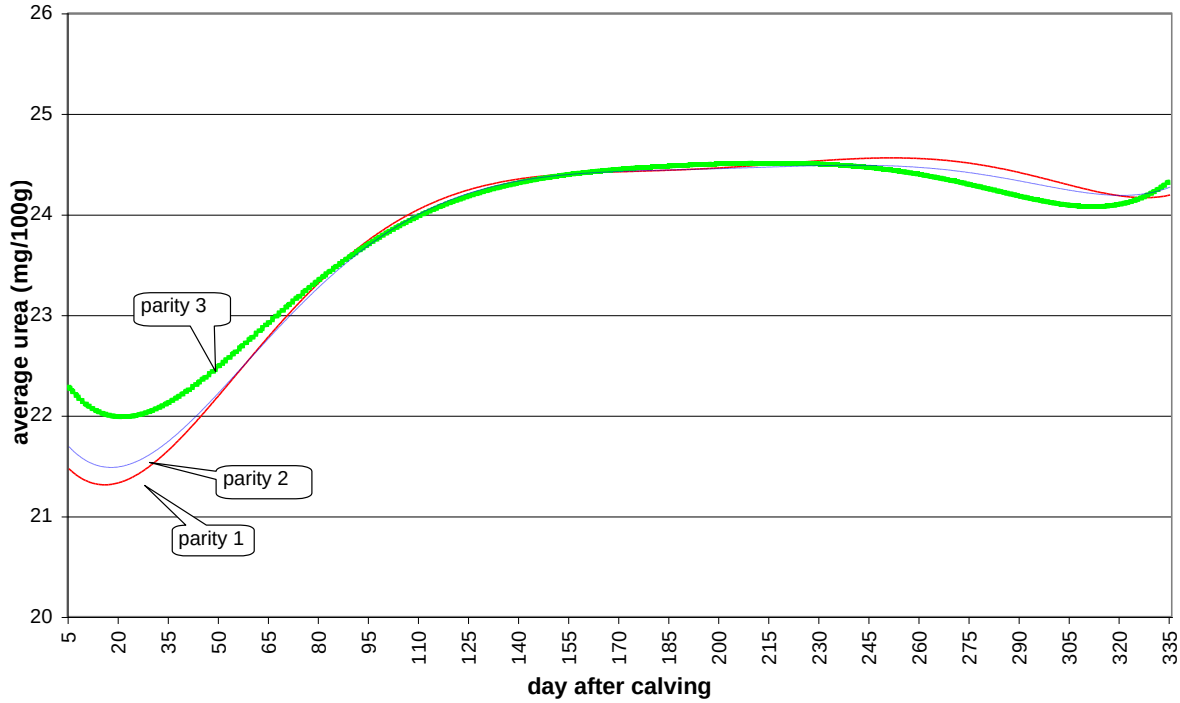

Figure 1. *Average urea per day in lactation 1, 2 and 3*

▪ Statistical model

The urea breeding value estimation is done with the test-day model, described in chapter E-7 of the CRV Handbook. 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 335 in lactation 1, 2 and 3. In the same way, the test-day model for urea gives breeding values for every day, from day 5 up to and including day 335 in lactation 1, 2 and 3. So every animal has its own genetic curve in lactation 1, 2 and 3.

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 0.23 and within lactation 1, 2 and 3 0.24, 0.23 and 0.22, respectively.

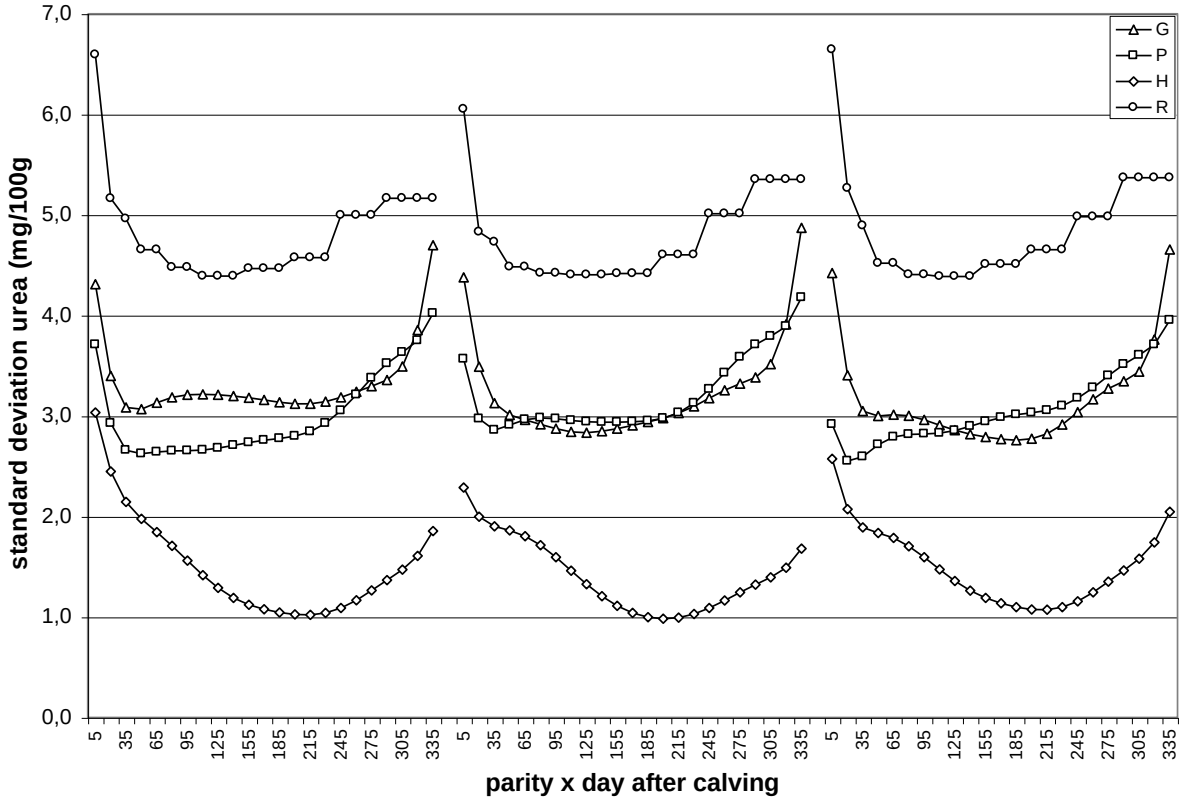

Figure 2. *Genetic (G), permanent environment (P), herd curve (H) and remainder (R) standard deviations for urea on day level for lactation 1, 2 and 3*

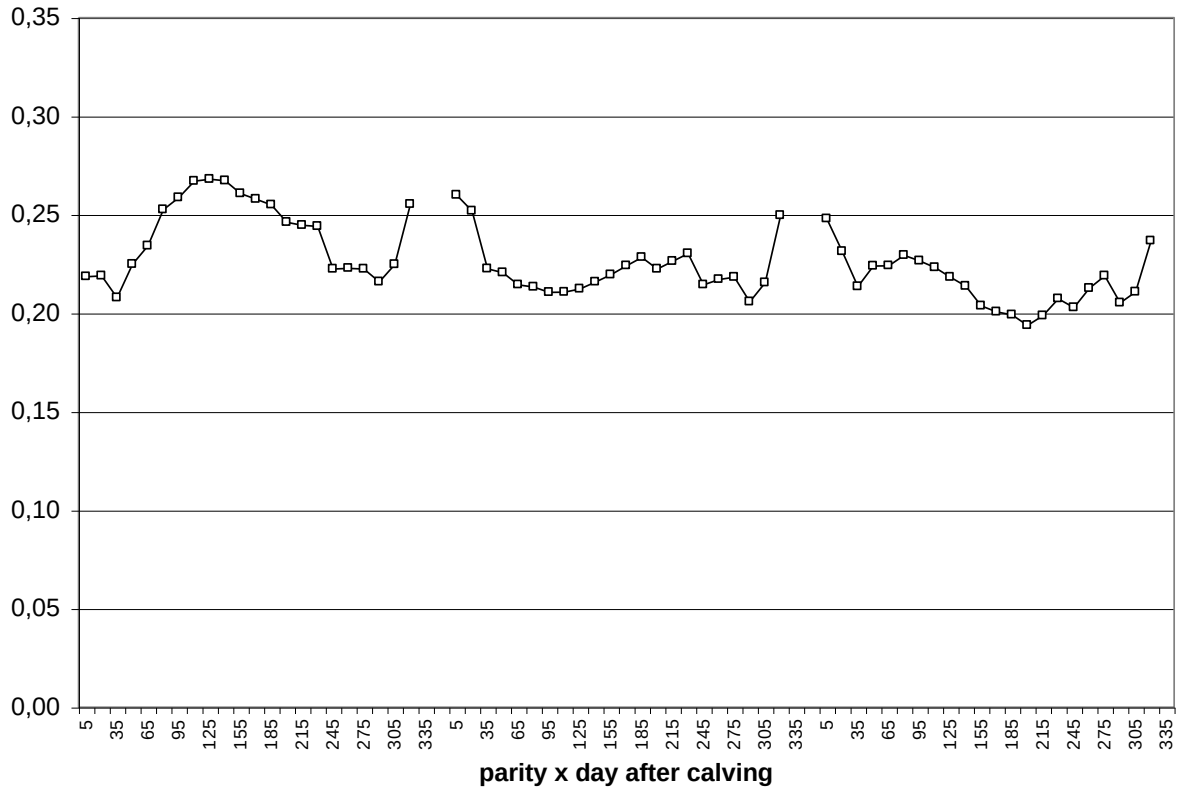

Figure 3. *Heritabilities for urea on day level for lactation 1, 2 and 3*

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, 2 and 3 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.

$$BV_{305,\ total} = 0.41 \times BV_{305,\ lactation\ 1} + 0.33 \times BV_{305,\ lactation\ 2} + 0.26 \times BV_{305,\ lactation\ 3}$$

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

Heritabilities for 305-days urea are 0.61, 0.54 and 0.53 for lactation 1, 2 and 3, respectively and 0.65 for total 305-days urea. The genetic correlations between 305-days urea in different lactations are 0.88 (lactation 1 & 2), 0.77 (lactation 1 & 3) and 0.87 (lactation 2 & 3). The genetic spread for lactation average urea in lactation 1, 2 and 3 is 2.9, 2.8 and 2.6, respectively and for total lactation average urea 2.7.

▪ 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 2.7 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 of sires are published on the 2010 base. This base is determined by the cows that were born in 2005. For the breeding values for urea 3 bases have been defined: a Black&White base, a Red&White base and a Local base. The definitions of these bases are as follows:

Black&White base (Z):
The herd book registered cows that were born in 2005 with at least 87.5% HF blood and 12.5% or less FH blood with Black&White color, with at least one observation in the breeding value estimation;

Red&White base (R):
The herd book registered cows that were born in 2005 with at least 87.5% HF blood and 12.5% or less MRIJ blood with Red&White color, with at least one observation in the breeding value estimation;

Local base (Y):
The herd book registered cows that were born in 2005 with at least 87.5% MRIJ blood and 12.5% or less HF blood, with at least one observation in the breeding value estimation;

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 1 shows the base differences for urea.

Table 1. Base differences for urea

	Z → R	*R → Y*	*Z → Y*
Urea	-0,1	-2,2	-2,3
Urea, lactation 1	0,2	-2,5	-2,3
Urea, lactation 2	-0,2	-2,1	-2,3
Urea, lactaiton 3	-0,4	-1,9	-2,3

▪ 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 Montbeliarde and MRIJ have higher breeding values for urea, on average well over one point and almost two points, respectively.

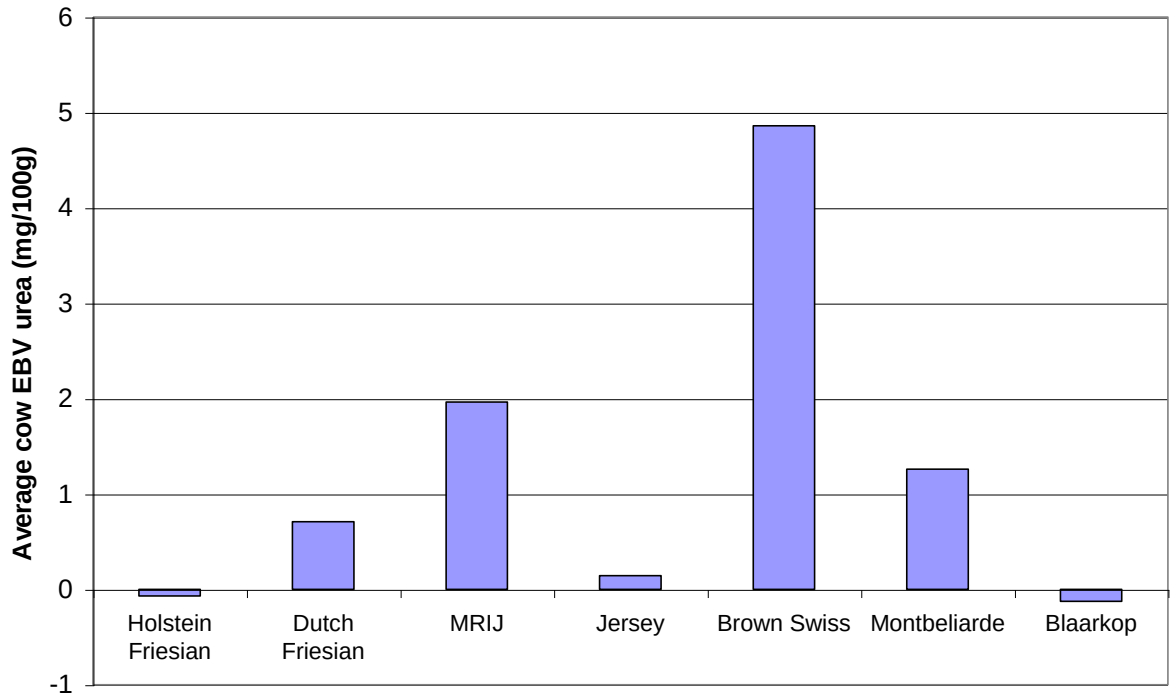

Figure 4. *Average cow breeding value for urea for seven breeds.*

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 2 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.

Table 2. 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 birth	of average breeding value	reliability
1995	0.4	75%
1996	0.2	75%
1997	-0.3	78%
1998	-0.2	78%
1999	0.0	79%
2000	-0.4	80%