GENETIC EVALUATION OF YIELD FOR DAIRY GOATS IN THE NETHERLANDS

C. Van der Linde and G. De Jong

NRS, PO Box 454, 6800 AL Arnhem, The Netherlands

INTRODUCTION

There are about 400 commercial goat herds in the Netherlands, with 100 to 800 does per herd. In total there are in the Netherlands about 70,000 does which are producing about 40 million kg of milk (De Groot *et al*., 1999). About 200 herds are participating in a three to six weekly milk-recording scheme. About half of the records are projected or realised 305-day yields, the other records are realised lactation yields with different lactation lengths.

The different goat breeds that are used for milk production are mainly the White Milk goat, but also the Toggenburger goat, Alpine goat, Spotted goat and the Nubian goat.

The dairy goat industry did not have enough tools to improve milk production of does by selection until 2000. A genetic evaluation for dairy goats provides farmers the possibility to optimise the breeding programme for goats and to select the best bucks and does of the population. Since July 2000 genetic evaluation for dairy goats is routinely carried out twice a year in the Netherlands.

The objective of this paper is to show the state of the art for the genetic evaluation of dairy goats in the Netherlands and to present a way to deal in the genetic evaluation with standardised and realised lactation yields with different lactation lengths.

MATERIAL AND METHODS

Data. The FW+ and ELDA organisations provided pedigree and production data for the genetic evaluation. Data in this paper originates from the genetic evaluation of January 2002 and was recorded in the period 1987 through January 2002. Pedigree was traced back as far as possible. Several checks on pedigree records were carried out: parents should have different identification numbers, parents should not be equal to the animal, age difference between animal and parents had to be at least 300 days.

Projected or realised 305-day yields or realised lactation yields with different lactation lengths were available. Realised yield was taken if the predicted or realised 305-day yield was not available. Therefore the genetic evaluation has been adapted to be able to deal with non 305-day yields.

Age at first kidding had to be at least 275 days, days between two kiddings at least 200 days. Maximum number of kids was 5, if the number of kids was more than 5, number of kids was set to 5.

Lactation length had to be between 100 and 800 days, lactations with other lactation length were excluded. Only records with known milk-, fat- and protein yield were taken. First three parities were included. At least one parent had to be known.

Model. The genetic evaluation is carried out with a BLUP animal model. All breeds in the data set are evaluated simultaneously. Lactations between 100 and 305 days were weighted according to lactation length to weight predicted 305-day yields and shorter realised yields less than realised 305-day yields. The weight factors for predicted 305-day yields were 0.88, 0.94, 0.98 and 1.00 for lactations with lactation length of respectively 100-120, 121-180, 181-240 and 241 to 305 days. The model used was :

$$y_{ijklmnopqr} = HYSP_i + MY_j + PAR_k + AGE_l + DP_m + GEST_n + LL_o + PE_p + A_q + E_{ijklmnopqr}$$

where $y_{ijklmnopqr}$ = milk, fat or protein 305-day yield or realised lactation yield (kg);
$HYSP_i$ = herd-year-season-parity (fixed);
MY_j = month-year of kidding (fixed);
PAR_k = parity * number of lambs (fixed);
AGE_l = age at kidding (fixed);
DP_m = length of drying period (fixed);
$GEST_n$ = length of gestation during lactation (fixed);
LL_o = lactation length (fixed);
PE_p = permanent environment (random);
A_q = animal (random);
$E_{ijklmnopqr}$ = residual (random).

Herd-year-season-parity. Lactations were evaluated within herd, year, season and parity (HYSP) classes, where second and third lactation were combined. The seasons consisted of three months from January through March etc. The minimum number of lactations per HYSP class was 5. HYSP classes with less than 5 observations were combined until 5 lactations were included in one year for the first lactation and within half a year for the second and third lactation. Classes with less than 2 records per class were excluded.
Month-year of kidding. Effect of month within year of kidding. This becomes more important if herd-year-season-parity classes are combined.
Parity-number of kids. Milk production is positively related to number of kids. Five classes from 1 to 5 kids and one class for unknown number of kids were made within parity.
Age at kidding. Monthly classes from 10 months to 55 months.
Length of drying period. Period in days between the last day in production of the lactation before and date of kidding of the current lactation. First parity and second and third parity combined are divided into classes of 10 days until 100 days. Observations with a length of more than 100 days or an unknown length are combined in one class.
Length of gestation. Length of gestation is calculated as 305 days minus open days. Classes consisted of 10 days, with different classes for 305-day lactations and realised lactations.
Lactation length. If 305-day yield is unknown, realised yield is taken. Does being more than 305 days in production have a higher realised yield. To compare lactations with different lactation lengths correctly, lactation length is divided into classes of 5, 10 or 20 days for respectively lactation length between 100 and 400 days, 400 and 600 days and 600 and 800 days. One class included 305-day yields.
Permanent environment. The doe has one permanent environment level per herd of production.
Heterogeneity of variance. Simultaneously with estimating EBVs, a correction for heterogeneity of variance is applied according to the method described by Meuwissen *et al.* (1996). In the heterogeneity of variance model, the error variance is adjusted for lactation length, age at kidding and herd-year effect. Herd-year effect is considered to be a random

effect with an autoregressive structure within a herd. Between herd-years a correlation of 0.95 is used and herd-year variance which is 10% of the error variance.

Breeding values. Unknown parents were replaced by phantom groups according to Westell and Van Vleck (1987). The phantom groups were based on selection path, breed, country of origin and year of birth. The minimum number of animals per group was 40. Groups were combined within selection path, breed and country of origin if one group contained less than 40 animals.

Lactations are considered as repeated observations on an animal. The heritability is 0.30 and the repeatability is 0.55 for milk, fat and protein (De Groot *et al.* 1999). For estimating the additive genetic variance, a genetic relationship matrix was included in the analysis.

RESULTS

In total, 44 373 lactations from 24 817 does descendant from 2,093 bucks producing in 211 herds were included in the genetic evaluation. Not all animals had projected or realised 305-day yields. The average known projected or realised 305-day yields for milk, fat and protein in kg were respectively 852, 33.9 and 28.2 for 15 696 first parity does, 949, 37.8 and 32.2 for 10,247 second parity does and 958, 38.0 and 32.4 for 5,770 third parity does.

Does born in 1996 with an own performance determined the base, both for the average of the breeding values and for adjustment of heterogeneity of variance. All breeds were included in one base. Breeding values are standardised to a lactation length of 305 days, age at kidding of 13 months and the average production level of the herds of production for the does included in the base. The genetic standard deviation of the base does was 87 kg of milk, 3.6 kg of fat and 2.8 kg of protein. The total number of animals with breeding values were 2,517 bucks and 33,401 does. Average breeding values per breed and number of animals for does and bucks are in Table 1. In total 322 phantom groups were defined, containing 18,370 animals.

Table 1. Average breeding values (kg) per breed and number of animals (n) for does and bucks for 305-day yield of milk, fat and protein

		average breeding value of does				average breeding value of bucks		
Breed	n	milk	fat	protein	n	milk	fat	protein
White milk	30,403	15	0.6	0.5	1817	21	0.7	0.7
Toggenburger	1119	-161	-6.6	-6.3	293	-195	-8.1	-7.4
Nubian	155	-114	2.1	-0.1	65	-113	2.3	0.1
Spotted	1137	-78	-2.3	-2.6	281	-97	-3.1	-3.2
Alpine	28	24	2.4	1.9	35	75	4.5	3.6
Others[A]	559	70	4.1	2.7	26	94	3.4	2.8
Total	33,401	6	0.3	0.2	2517	-20	-0.6	-0.7

[A] Crossbreds or unknown breed

Adding lactation length to the model made it possible to analyse projected or realised 305-day yields together with realised lactation yields with different lactation lengths. But longer lactations have a larger phenotypic variance. By including lactation length in the model and in the correction for heterogeneity of variance, lactations with different lactation lengths could be analysed in one genetic evaluation.

Average breeding values for 305-day yield of kg of milk, fat and protein of does in the Netherlands per year of birth are in Table 2, showing a clear positive trend in the period 1992 – 2000.

Table 2. Average breeding values (kg) for 305-day yield of milk, fat and protein and number of does (n) per year of birth

year of birth	n	milk	fat	protein
1992	1090	-22.2	-0.9	-0.9
1994	2018	-15.4	-0.5	-0.6
1996	4183	-1.2	0.0	0.0
1998	4889	19.9	0.9	0.7
2000	3333	40.0	1.7	1.5

Analysis of genetic ties by bucks across herds showed that on average about one third of the does in a herd is offspring of a buck having offspring in other herds. Thirteen percent of the herds have no does being offspring of bucks with offspring in other herds. In general, the bucks with offspring in just one herd are bought from another herd and therefore these herds still have some genetic ties with other herds.

Analysis of milk production and number of kids showed a positive correlation between milk production and number of kids (correlation is 0.20, B.J. Ducro *pers. comm.*). The difference in production for a first parity goat is +47 and +70 kg of milk (305-day yield, after adjustment for heterogeneity of variance), +35 and +56 kg of milk for the second parity and +29 and +43 kg of milk for the third parity, for goats with respectively 2 and 3 kids compared to 1 kid.

Ranking of does and bucks for publication is based on kg of fat and protein. Breeding values of bucks for kg of fat and protein ranged from 30 kg to –23 kg.

CONCLUSION AND IMPLICATIONS

Genetic evaluations for dairy goats are carried out twice a year. Lactations from different milk recording systems can be combined into one genetic evaluation. There is a clear positive genetic trend in milk production traits. Genetic ties by bucks exist, only 13 percent of the herds have no genetic ties with other herds. The implementation of a genetic evaluation system is likely to improve current selection decisions. The genetic evaluation may therefore result in higher selection efficiencies within the current Dutch breeding programme for AI bucks.

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