Consequences of a simplified milk recording method on estimation of lactation yields and genetic evaluations for dairy traits in goats.

V. Clément[1] ,C. Carillier[1], A. Piacère[1], C. Robert-Granié[2], H. Larroque[2]

[1] Institut de l'Elevage, 24 Chemin de Borde Rouge, Auzeville, CS 52627, 31326 Castanet Tolosan cedex
[2] INRA, UR631-SAGA, BP 52627, 31326 Castanet-Tolosan Cedex, France

Abstract

In French goat breeding, milk recording relies on 3 official recording methods for dairy traits: A, AT and AZ as defined by ICAR rules. This study evaluated the adequacy of a simplified design based on spacing records. The first result was that such a recording system is difficult to implement in farm. Moreover, lactation yields and contents estimated in these conditions showed biases and losses of accuracy. Finally, using these performances estimated with a simplified recording method had consequences on EBVs, mainly resulting in re-rankings of reproducers.

Introduction

Herd size of French dairy goats has increased of 34% to reach an average of 200 goats per herd (for breeds in official milk recording system) in the last ten years. This observation, in addition to high costs and inconveniences of milk recording, have made simplification of sampling procedures a major concern of milk recording organisations. Proportion of alternate methods, with regard to A or AZ designs, increases each year to reach currently 47% (Institut de l'Elevage, 2012). Milk recording organisations, which already use AT design are searching for more simplified protocols usually based on spacing records. The aim of this survey was to simulate a simplified design, called method "3 records", on a variable proportion of herds, and then to evaluate 1) the possibilities for applying this design in practice, 2) the consequences on estimated lactation yields and contents, and 3) the consequences on the estimated breeding values (EBVs) in comparison with the official test methods.

Material and methods

Preliminary results have shown that the most representative part of the lactation is located between 70 and 190 days in milk. Indeed, estimated heritability at test-day, quite low before 70 days in milk, increase after this stage. In the same way, the 70-190 days in milk period exhibits the highest genetic correlation between individual test-day and whole lactation. The simplified design tested in this study is based on 3 records per animal. In order to reduce significantly the mean number of visits (which is currently around 7), and to avoid large intervals between records which can discard the lactation, we focused on herds having had 3 to 5 visits during the 70-190 days period of 90% of animals, which corresponds to herds with span time between the first and the last kidding up to 4 month. Once data of these herds have been identified among data from official recording, several situations have been tested. The design "3 records" has been simulated on 3 data sets: data from a French department with mainly A design, data from a French department with only AT design and data from all French departments. The percentage of herds on which we have applied the "3 records"

design was 30% or 90% when it was applied on one department, and 30% and 60% when it was applied to all departments. Simulations have been realized from 1 year or 4 successive years of recorded data.

Fleischmann's method has been used to compute lactation dairy performances considered in official genetic evaluation (milk yield, fat and protein yields, fat and protein contents). Formulas taking into account parity and days in milk allowed to extrapolating production for a reference lactation of 250 days. These formulas are currently used for lactations in progress in official genetic evaluation.

To evaluate adequacy of the "3 records" design, bias (defined as the difference between performance estimated with simplified data and performance estimated with initial design) and loss of accuracy (equals to $1-R^2$, R^2 being the correlation between the two estimated performances) have been computed.

All estimated performances from simplified design have been included in genetic evaluation with official data. EBVs obtained have been compared to official EBVs.

Data file used for genetic evaluation included 7.2 millions of lactations for 2.6 millions of females.

Results

Dairy performances estimated

Correlations between performances estimated with simplified design or with initial design (A or AT) ranged from 0.86 to 0.94 depending on the traits and the simulation studied, the lowest correlation being observed for fat yield.

When performances were computed from simplified data, biases occured for every trait as reported in table 1. Yields were overestimated (from 3% to 8.5% for milk for the most extreme case) whereas contents were underestimated. A loss of accuracy have been observed, in particular for fat content when the simulation was implemented on alternate recording (46%) data.

Table 1. Biases and loss of accuracy of dairy performances estimated with a "3 records" design compared to A or AT design.

	Bias (%)		Loss of accuracy (%)	
	A	AT	A	AT
Milk yield	8.5	7.5	13	18
Protein yield	4.2	3.1	14	36
Fat yield	3.5	2.6	15	25
Protein content	-3.8	-3.8	16	25
Fat content	-4.1	-3.8	25	46

Analysis of variance (performed with the GLM procedure of the software package SAS (SAS Institute Inc., Cary, NC, USA) have shown that some factors had a significant effect on biases. These factors were the herd, the level of production, the month of kidding (the two last factors being in interaction), and the number of records in the initial design. In contrast to A design, where no clear trend could be reported, biases were more important for AT method when the level of production is high. For this factor, the biases were even higher than the number of records was important. Some of them were specific to the AT design such as the proportion of a.m. records. Thus, fat content was underestimated when the number of a.m. records was higher.

Estimated breeding values

Correlations between EBVs estimated with simplified design or with A/AT design were high : 0.99, but decreased to 0.93 when only first lactations were considered.

To assess the impact of simplified design in genetic evaluation, intra-herds rankings have been realized. The percentage of animals changing of third in herd was relatively low as reported in table 2.

Table 2. Re-ranking intra-herds

Re-ranking by third	Percentage of animals
-2	< 0.01
-1	0.50
0	99.0
1	0.50
2	< 0.01

The choice of the best females on EBVs (i.e. dams of bucks used for selection scheme) was modified when data computed from a simplified design were introduced in genetic evaluation. Table 3 showed that, depending on the simulations, from 1 to 16% of the 3,200 best females could be replaced by others when data were collected with a "3 records" design. The difference of means of the yield merit index (which included protein and fat yields and protein and fat contents) between the two groups of females was around 0.5 point for a standard deviation of 2.4.

Table 3. Variation in the choice of best female on EBVs when data recorded with a simplified design were included in genetic evaluation.

	1 year			4 years
Initial design	AT	A	A + AT[1]	A + AT[1]
% of female replaced (%)	1.0	2.0	6.6	16.5
Variation of selection criterion of replaced females	+ 0.56	+ 0.47	+ 0.49	+ 0.50

[1] the A+AT design corresponds to the simulation on all French departments

The ranking of AI bucks on yield merit index was slightly affected: few inversions have been occured between two bucks, but the ranking stayed the same.

Discussion

The simulation step has shown that it was difficult to implement the "3 records" design because of the spreading of kidding period. Only 40% of the French goat herds had a kidding period of less than 4 months. This factor is depending on breeding practices, especially the fact that the breeder sells milk or produces cheese. Therefore, in the cases of kidding occuring on a long period, a "3 records" design seems to be difficult to apply on farm.

Biases and losses of accuracy observed on dairy yields, in particular for alternate design were similar to those reported by Bouloc et al. (1991). Otherwise, as we have noticed in AT method, Leclerc et al. (2004) observed, in dairy cattle, that biases increased with the level of production. The variation on fat content has been highlighted by Bouloc (1991) who explained that fat content is 27% higher at the evening milking that at the morning.

The results obtained in this survey suggest that the use of performances computed from a simplified design for management purpose is unreliable. One solution to increase the accuracy is to override the alternation in keeping in the simplified recording system the same number of a.m. and p.m. records. Adjustment factors based on milking intervals proposed by Liu et al. (2000) for alternate design can be a way of improvement, without therefore suppressing the entire loss of accuracy. Extrapolation formulas used take into account days in milk, since this factor have been identified for having a high impact on performances estimation (Everett & Wadell, 1970; Leclerc et al., 2004). However, a revision of formulas could be considered, in particular to fit the level of production of animals.

Effect of simplified design on EBVs was low when we considered the whole population: correlation was equal to 0.99 and intra-herd re-rankings were few. However, analyze of a specific population as bucks dams showed that the use of too simplified designs data could be damaging for the selection scheme. The weighting of the designs according to the number of records and the method (A/AT) could be a way to minimize the part of simplified design in genetic evaluation.

Conclusion

This survey has exhibited that this “3 records” design can be implemented only in herds with short time span between the first and the last kidding, to be more precise a kidding period spreading over 4 months.

Another result is that use of performances computed with this simplified recording system for technical advices is not reliable, as well as for genetic evaluation. Some ways of improvement to compute performance can be proposed, as an even number of records for AT design, the applying of adjustment factors or the revision of extrapolation curves. For genetic evaluation, the weighting of all designs according to their accuracy would give less importance to data collected with a simplified design. Another solution for genetic evaluation is to use a test day model.

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