ESTIMATION OF BREEDING VALUE OF BEEF BULLS IN PERFORMANCE TEST STATION IN FRANCE

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SUMMARY

The estimation of breeding value, in performance test station, for future natural mating sires, combined two evalution procedures : the national evaluation by BLUP animal model of all bulls already performance tested, and local evaluations on personnal computers, by the modified contemporary comparaison method. This second evaluation procedure includes the performance of tested bulls and breeding values of their parents estimated in the former national evaluation. (i) National BLUP animal model evaluation can be used to assess the efficiency of the selection. (ii) The local evaluation by modified contemporary comparaison allows an increase of accuracy by 15 to 25 % as compared to the local evaluation by contemporary comparaison.

INTRODUCTION

Because of the importance of natural mating in the french beef herds, performance test stations have been developped since about ten years (Menissier, 1987). These stations provide breeders with bulls whose breeding values for growth and conformation have been estimated by reliable procedures, under same management conditons and according to single performance recording. More than 1500 bulls from specialized or dual purpose breeds are tested annualy in 16 stations (only one breed controled by station).

To reduce at the minimum the time between the end of test and the qualification of bulls by the breed organisation, required before the sale of bulls, breeding values are estimated locally on personnal computers and according to unique national procedure. Until 1993, breeding values were estimated by the contemporary comparaison method.

Now, the evaluation system consists in two levels : a national level where a national evalution is performed annualy, for each breed. Breeding values are estimated by a BLUP animal model including all performance tested bulls of the past years. This evaluation is mainly used to assess the efficiency of this step of selection. The second level is a local running level, where breeding values are estimated by a modified contemporary comparaison method, including the breeding values estimated by the former national level. The objective is to increase the accuracy of the running evaluations.

This paper discribes these two aspects in the case of the *charolaise* performance test stations.

MATERIALS AND METHODS

Data of 7 *charolaise* stations collected between September 1984 and February 1993 have been used. The test duration is about 6 months in station : 4 weeks for adaptation, 4 months of test and at least 2 weeks of preparation for sale. During the test period, bulls are fed ad libitum with forage lightly complemented in order to reach an average growth rate of 1400 g/d. Bulls are weighed every month and scored (muscular and skeletal development) at the end of test by experts. The considered traits are :(i) Muscular and skeletal scoring (MD, SD). (ii) Weight at the end of test adjusted for age (FW) estimated as an optimal index which combines weight at the beginning of test adjusted fort age (IW) and the average daily gain during the test (ADG).

For the evaluations, we use the following usual genetic parameters (h^2=0.2 0.3 0.3 and 0.3 σ_g=17.0kg 0.105kg/d 3.7pts 3.5pts respectively for FW, ADG, MD et SD, phenotypic and genetic correlations of 0 except the genetic correlation of 0.45 between IW and ADG).

The estimation of breeding values by contemporary comparaison ($\hat{G}_{CC}$) takes into account a fixed effect for a "contemporary group" of at least 15 bulls with maximum difference in age of 42 days from the same "test group x year x station", and a linear regression on age at scoring for MD and SD. The accuracy of $\hat{G}_{CC}$ (CD) is

equal to the heritability. The 440 performance tested bulls during the last year (from september 1992) were evaluted according to this procedure.

The estimation of breeding value by BLUP animal model is based on the same model than by contemporary comparaison. According to a preliminary study (Journaux, 1990), pedegrees are used with only two genetrations of ancestors (between 1984 and 1992 : 3329 bulls performance tested, born from 1228 sires and 2723 dams, and 4834 grand parents). The solutions for BLUP animal model ($\hat{G}_{Bma}$) evaluation are obtained with the program PEST (Groeneveld, 1990). Their accuracies are calculated according to the theory of selection index. The calculation takes into account : (i) for a bull : his own performance, the one of his father, those of his progenies, those of his half-sibs from father ; (ii) for a female : performance of her progenies, the one of her father, those of her half-sibs from father (Wilmink et Dommerholt, 1985).

The estimation of breeding value by modified contemporary comparaison is based on the method of the "cumul d'indices" (Colleau and Poutous, 1973). For a bull in test station, two informations are available : (i) his own breeding value estimated in station by contemporary comparaison from his own performance ($\hat{G}_{CC}$) ; (ii) his breeding value estimated from ancestry ($\hat{G}_{asc}$) : the breeding values of his parents obtained by BLUP animal model at the national level.

$$\hat{G}_{asc} = \frac{1}{2}\left(\hat{G}_{Bma,sire} + \hat{G}_{Bma,dam}\right) \qquad CD_{asc} = \frac{1}{4}\left(CD_{Bma,sire} + CD_{Bma,dam}\right)$$

The breeding value of the bull ($\hat{G}_{CCm}$) is now :

$$\hat{G}_{CCm} = \frac{1-h^2}{1-h^2 CD_{asc}}\hat{G}_{asc} + \frac{1-CD_{asc}}{1-h^2 CD_{asc}}\hat{G}_{CC}$$

and his accuracy is :

$$CD_{\hat{G}_{CCm}} = \frac{CD_{asc} + h^2 - 2h^2 CD_{asc}}{1-h^2 CD_{asc}}$$

If, for a bull, one or both parents are unknown, their breeding value is supposed equal to 0 with an accuracy of 0. The breeding values ($\hat{G}_{CCm}$) for the 440 bulls tested during last year were evaluated according to this procedure.

The correlations between the different breeding values ($\hat{G}_{CC}$, $\hat{G}_{CCm}$, $\hat{G}_{Bma}$, and $\hat{G}_{asc}$) were calculated for the 440 bulls of the last year.

RESULTS AND DISCUSSION

The performance and parameters for all performance tested bulls are given in table 1.

The accuracy : 65 % of the 440 performance tested bulls have at least one parent with an estimated breeding value (the sire in 89 % of cases, the dam in 32 % of cases) and 14 % among of them have both parents already evaluated. The accuracies of the breeding values of sires are 0.38±0.23. The accuracies of the breeding values of dams are 0.17±0.08. This supplementary information results in a relative increase between +15 % and +25 % of the accuracy of the modified contemporary comparaison as compared to the breeding values estimated by contemporary comparaison, according to the heritability of the traits. Thus, for a trait with an heritability of 0.2, the accuracy for breeding value estimated by modified contemporary comparaison averages 0.25.

The table 2 gives the correlations between the breeding values estimated by the different methods, according to the quantity of information known for the parents. The correlation between $\hat{G}_{asc}$ and $\hat{G}_{Bma}$ for a bull is between 0.35 and 0.50. These values are consistent with the expectations. Furthermore, the correlation between $\hat{G}_{CCm}$ and $\hat{G}_{Bma}$ is greater by 0.06 than the correlation between $\hat{G}_{CC}$ and $\hat{G}_{Bma}$ for the 440 tested bulls. This difference is more important for the group of bulls where at least one parent has a breeding value already evaluated and even more if both parents have nationally been evaluated.

The genetic trend : the table 3 gives a genetic trend for the FW of the tested bulls since 9 years. The overall genetic trend realized by all the stations is relatively low (+1% of genetic standard deviation per year). Only the station 892 has a very more important progress (+6% of genetic standard deviation per year). In 1986,

it had a bad genetic level. Now, with a more accurate selection of bulls at the end of test and with a better use of these bulls (the 2 or 3 better bulls of each year are used by artificial insemination, the daugthers of these bulls are keeped as heifers) it has an average genetic level higher than the most of the other stations.

CONCLUSION

These two examples show, for beef bulls performance tested in station, the interest of an annual and global estimation of breeding value by a BLUP animal model associated with a "test group x year x station" estimation by modified contemporary comparaison. This latter method increases the accuracies of the estimations of local breeding values, and the efficiency of selection, without delaying the use of the performance tested bulls for natural service. In other hand, the annual estimation of breeding values by a BLUP animal model is an efficient way to measure and to control the efficiency of the selection of the future tested bulls and the efficiency of the selection at the end of test. Though this system has been currently used, we have to check the importance of connectedness between station x test groups to optimize breeding value evaluations.

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table 1. Means and standard deviations for variables on all bulls

trait	number	phenotypic mean	phenotypic standard deviation	genetic standard deviation
FW* (kg)	3329	-	44.7	25.3
MD (sur 100)	3329	72.0	6.8	3.7
SD (sur 100)	3329	71.1	6.5	3.5

** Standard deviations for FW were calculated for 4 months of control.*

table 2. Correlations between genetic values estimated by contemporary comparaison, modified contemporary comparaison and BLUP animal model *

trait	all animals controled	at least one parent with breeding value	only bull with breeding value	only dam with breeding value	two parents with breeding value
number	440	284	192	31	61
Weight at the	0.87	0.85	0.81	0.71	0.79
end of	0.96	0.96	0.94	0.86	0.92
control(1)	0.48	0.56	0.47	0.69	0.71
Muscular	0.87	0.85	0.87	0.57	0.58
development	0.91	0.92	0.93	0.57	0.83
	0.39	0.47	0.50	0.09	0.56
Skeletal	0.88	0.89	0.85	0.79	0.77
development	0.94	0.96	0.94	0.82	0.88
	0.42	0.44	0.43	0.50	0.55

* First line : correlation between breeding values estimated by contemporary comparaison and by BLUP animal model

second line : correlation between breeding values estimated by modified contemporary comparaison and by BLUP animal model

Third line : correlation between ascendance breeding values (estimated by BLUP animal model) and breeding values of performance tested bulls estimated by BLUP animal model

table 3. annual trend, by station, of FW breeding value for controled bulls (1) :

station	average number per year	year of control								
		1984	1985	1986	1987	1988	1989	1990	1991	1992
211	39	0,0	1,6	0,0	2,8	-4,4	1,6	4,4	8,3	-0,8
231	31			1,2	-1,2	-1,6	6,3	1,6	-2,8	2,0
511	39	7,5	10,3	-5,2	9,5	-4,0	5,2	9,9	14,3	9,1
581	45	2,4	0,4	0,4	2,8	7,1	1,6	4,8	10,7	7,5
711	65	3,2	-2,0	-0,8	0,4	-2,0	-5,6	2,8	1,2	3,6
891	70	-3,2	-5,6	-3,2	-2,8	-6,3	-5,2	-0,4	6,7	-1,6
892	112			-30,5	4,0	-14,7	-26,6	19,0	-1,6	27,8
total	401	2,0	0,0	-7,9	2,0	-6,0	-8,3	7,9	4,0	10,3

(1) Breeding value in pourcentage of genetic standard deviation, in difference whith breeding value of bulls controled during the last five years.