

Recommendations for a Planned Progeny Test Design and Connection in French Dairy Cattle

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Introduction

Breeding schemes in dairy cattle are based on the progeny test of a large number of bulls, and on the selection of the best bulls after their first proofs. The efficiency of such a system can be highly reduced, if some biases affect the proofs of young bulls. First crop daughters are generally supposed to be randomly distributed in the space, and to be bred in the same conditions as second crop daughters. Nevertheless, as only a few recommendations are generally made on progeny test practices, the conditions of progeny test in various AI studs within a same country can be different. Some of these practices can lead to the opposite of the objective and they may lead to a different treatment of first and second crop daughters in a same herd. Moreover, even if most of the connections between regions are due to the bulls returned to service, a distribution of doses of young bulls in a too small region may be dangerous, because there may be a confusion between a local effect that is not taken into account in the evaluation and the genetic value of the bull.

In the three main French dairy breeds, several recommendations were made many years ago in order to organise the collect of type data of 1st crop daughters and to guaranty a minimum connection level between regions during progeny test (Institut de l'Élevage, 1992; Institut de l'Élevage – UPRA Normande, 1995; Institut de l'Élevage – UPRA Montbéliarde, 1996). But until now, no general recommendation was done on other points such as the distribution of dams sired with young bulls (parity number, genetic level...) or on incitements to encourage progeny test. Moreover, several French studies showed that small discrepancies between proofs of bulls belonging to different AI companies were probably due to heterogeneous designs of progeny test and that they could not be corrected in the genetic evaluation. These discrepancies, even small, could lead to unjustified (dis)advantage in

bull ranking, as the difference between the proofs of the best bulls is often very small.

Therefore, a survey has been done in 1998-1999 in all the AI companies of the 3 major French breeds (Holstein, Normande, Montbéliarde) in order to assess how the progeny test was organised in each case. In a second time, several studies have been done on national data, firstly to validate the results of the survey, secondly to test various potential sources of biases in the genetic evaluations, due to inappropriate practices of progeny test. Then, recommendations have been made and a first “Planned design of progeny test” has been validated and has been applied for one year. This paper summarises the different steps of this work. Not all the results and studies could be presented here. The main conclusions and recommendations are indicated in the last part.

Main results of the survey on conditions of progeny test

Each AI company who answered the survey should describe the situation as precisely as possible and indicate any difference in the design that could exist in its various AI membership cooperatives.

The progeny test is not organised directly by the AI companies but by the local AI coops membership to these AI companies. AI are randomly distributed in the herds, and in the majority of the cases, AI are made on cows in 1st parity. In most AI studs, breeders are encouraged to use a young bull thanks to various incitements, such as a financial help or free doses of the best proven bulls. When the survey was done, these incitements could be very different from a region to another, and the conditions for a breeder to receive these helps were also heterogeneous. The most important difference between AI studs was on the minimum lactation length of the 1st crop

daughter required to receive the helps (1 or 4 test-days). Moreover, the amount of the grant, in some AI studs, could depend on the age of the 1st crop daughter at her 1st calving.

Results of the studies on national data

Effect of requirements based on a minimum lactation length to receive incitements

French administrative regions (French « Départements ») were separated into two different categories according to the policy of the local AI stud on minimum number of test days required for receiving incitements. In the first group (“4 TD”), the minimum requirement was of 4 test days, in the second one (“1 TD”), AI studs were requiring only one test day. Undetermined regions were excluded, when many AI studs were located in the same region and when these AI studs had not the same minimum requirements.

Percentage of short lactations. Holstein recorded cows with a first lactation started between September 1st, 1997 and September 1st, 1998 were considered in this study. These cows were divided into 4 categories, according to the status of the region (1 TD/4 TD) and the status of their sire (proven or young bull). A short lactation was defined as a complete lactation of less than 120 days. Table 1 shows that in regions “4 TD”, there was no difference between the percentage of short lactations of 1st and 2nd crop daughters. In “1 TD” regions, this percentage was higher for 1st crop daughters.

Table 1. Percentage of short lactations according to the status of the cow (2nd vs 1st crop daughters) and to the region (1 TD - 4 TD).

Status of the cow (number)	1 TD ^(a)	4 TD ^(b)	Differenc e 1 TD-4 TD
1 st crop (100311)	4.9	3.4	+1.5
2 nd crop (569192)	3.8	3.5	+0.3

^(a): regions with incitements given after 1 test-day;

^(b): regions with incitements given after 4 test-days

The same study has been done on two neighbouring administrative regions (Meuse and Meurthe et Moselle) in same AI company, but

having different minimum of requirements on lactation length (Table 2). Only daughters of common bulls were selected. Even with very close breeding conditions and with the same sires, the percentage of short lactations was still higher in the region “1 TD” for 1st than for 2nd crop daughters.

Table 2. Percentage of short lactations according to the status of the cow (2nd vs 1st crop daughters) and to the region (1 TD - 4 TD): results restricted to cows born in Meuse and Meurthe et Moselle.

Status of the cow	1 TD ^(a)	4 TD ^(b)	Differenc e 1 TD-4 TD
1 st crop	5.9	4.1	+1.8
2 nd crop	4.3	4.4	-0.1

^(a): regions with incitements given after 1 test-day;

^(b): regions with incitements given after 4 test-days

Interpretation of the results. A strong selection is used to be done at the beginning of the 1st lactation. A cow whose beginning of lactation is very disappointing, is generally rapidly culled because keeping such a cow is not profitable. Culling often occurs before the first test-day to avoid milk recording fee. Therefore, such cows have no recorded performance. In the case of 1st crop daughters, the owner of a very low-producing cow is encouraged to keep his female if he has not to wait too long to receive the incitements (case of “1 TD” regions). He will not keep his female, if he has to wait 4 months.

Therefore, some 1st crop daughters that were kept in “1 TD” regions would not have been kept if they had been 2nd crop daughters or if they had been in other regions. These females have generally a very short lactation, which penalises their sire, in comparison with the other regions and to the proven bulls.

Effect on genetic evaluation. For each cow, INRA computed individual daughter yield deviation, i.e. average performances adjusted for all environmental effects and half breeding value of her dam. These DYDs were multiplied by 2 to be comparable to EBVs and were analysed with a model accounting for sires and regions. These regions were defined by the type of incitement (1 TD/4 TD).

Table 3. Regional effect on individual DYDs: Protein Yield (EBV, kg) ^(a).

	1 st crop daughters	2 nd crop daughters
Effect of 1 TD region (in comparison to 4 TD)	-1.52 +/- 0.65	-0.04 +/- 0.17

^(a): 1 TD = regions with incitements given after 1 test-day;

4 TD = regions with incitements given after 4 test-days

In Holstein breed (Table 3), the difference between these region effects was not significantly different from zero for 2nd crop daughters, which shows that the environmental effects in the two different areas are well corrected in the French genetic evaluation. At the opposite, a disadvantage of the regions “1 TD” was noticed with the 1st crop daughters. The same effect computed on performances of Montbéliarde cows was much higher, with a disadvantage of 5.6 kg Protein (+/- 1 kg) for the cows in regions “1 TD”. The higher value in Montbéliarde may be due to the fact that the incitements are much higher in regions “1 TD” with a majority of Montbéliarde cows.

This study clearly shows that the conditions to give incitements for progeny test may affect the proofs of the young bulls. When the helps are given too early, the 1st crop daughters are not bred as the 2nd crop daughters. 1st crop daughters are kept until their first test-day, even when they have a very low yield. This first control, which is taken into account in the genetic evaluation, highly penalises the proof of the young bull. Therefore, it has been recommended to give helps (if any) after the 4th month of lactation.

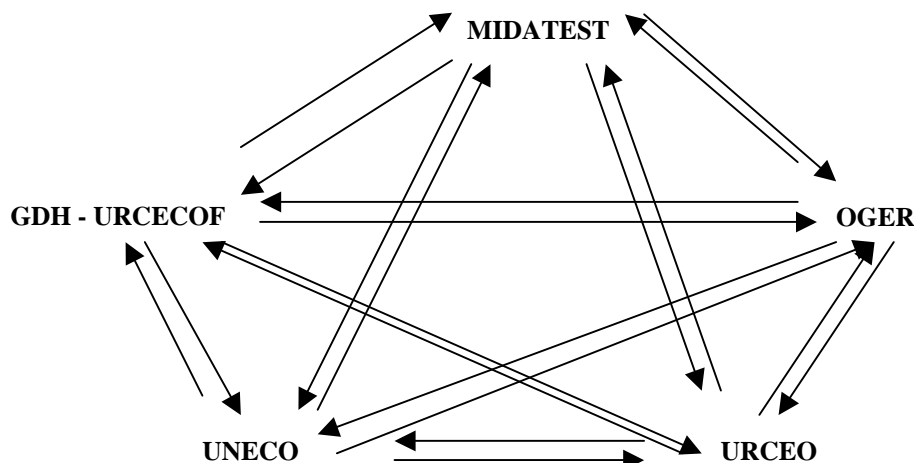
Connection between regions

Since 1986, connections between AI units have been planned in Holstein breed for bulls in progeny test. This connection design is based on the exchange of AI doses of 100 bulls over the 650 progeny tested each year between the 5 French AI companies (as two companies, Genes Diffusion Holstein and URCECOF are used to work together for a long time, they have been grouped in the national design). Each AI unit receives 70 AI doses of 5 bulls of the 4 other AI companies (Figure 1). This design is intended to provide 100 first crop daughters per region and AI company of origin. The aim of such a connection plan is:

- To encourage the progeny test of bulls on the largest area as possible
- To permanently have enough connections between areas to check different new effects in the models of evaluation. Although connections are quantitatively much more important with 2nd crop daughters (Hanocq and Boichard, 1999), this additional design provides a high-quality data set for validation studies, because it is not susceptible to preferential treatment.
- To have connections through 1st crop between the technicians scoring cows in various areas.

This connection design did not take into account the size of the AI units, which varied from 40 to 250 bulls progeny tested each year. Moreover, for several years, some AI units have had agreements and they have been exchanging more AI doses of young bulls than required in the national connection design. Therefore, the connection design was analysed in order to be updated.

Figure 1. Connexion plan in Holstein breed implemented in 1986.



Each arrow indicates a flow of 70 first AI of 5 young bulls from the AI company which owns the bull to another.

Data. 1st AI of bulls progeny tested between September 1997 and October 1998 were included in the analysis (206 576 1st AI). 5 areas were defined, corresponding each AI company. In each area, the number of AI of each bull was computed. AI were discarded from the analysis if:

- The bull had less than 200 AI in total
- In the considered area, there were less than 25 first AI of the same bull

The AI were analysed by using the Genetic similarity as defined by Rekaya *et al.* (1999):

$$GS_{ij} = \frac{\sum_{k=1}^2 \sum_{l=1}^{CB_{ij}} ND_{lk}}{\sum_{k=1}^2 \sum_{l=1}^{TB_{ij}} ND_{lk}}$$

in which ND_{lk} is the number of first AI of each bull, CB_{ij} is the number of bulls with AI both in i and j and TB_{ij} is the total number in the AI studs i and j .

The actual results were compared to those expected by taking only the national connection plan into account (Table 4).

Table 4. Degree of genetic similarity between pairwise AI company combinations in Holstein young bull populations.

OGER	URCEO	URCECOF	MIDATEST	GDH		Nb first AI
0.027(0.031)	0.025(0.032)	0.014(0.017)	0.045(0.038)	0.027(0.019)	UNECO	62812
/	0.142(0.047)	0.02(0.031)	0.253(0.064)	0.062(0.029)	OGER	33716
	/	0.03(0.031)	0.095(0.065)	0.036(0.029)	URCEO	28994
		/	0.054(0.043)	0.277(0)	URCECOF	4776
			/	0.074(0.051)	MIDATEST	16173
				/	GDH	31947

In parentheses : Genetic similarity GS' estimated by considering only the planned connections. GS' has been computed by considering the actual total numbers of AI of each company, and by assuming that each common young bull has 350 first AI. $GS' = 0$ between URCECOF and GDH since these AI companies are merged in the national connection plan.

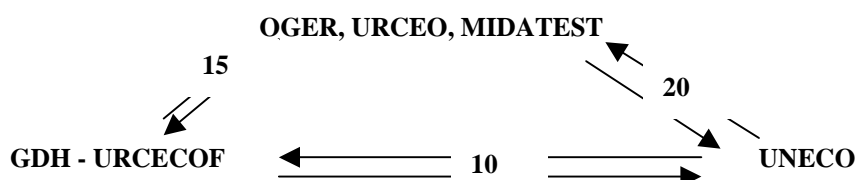
In most of the cases, the GS degree between two AI units is at least equal to the recommended value (GS'). The degree of GS is higher when an agreement between AI units exists (GDH and URCECOF, OGER and MIDATEST, OGER and URCEO). Otherwise, connections between pairs of AI companies during the progeny test are only

due to the national connection design. Therefore, a new connection design has been proposed (figure 2). The number of exchanged bulls is unchanged. This new plan takes all the agreements between AI units into account. The connections are focused on the pairs of AI companies which do not organise other exchanges

of AI doses of young bulls. This is why there are more bulls exchanged with UNECO, and GDH-URCECOF than previously (60 bulls instead of 40 for UNECO, 50 instead of 40 for GDH-URCECOF). A third group has been created, with OGER, URCEO and MIDATEST. Within this last

group, the connection is not planned nationally excepted between URCEO and MIDATEST. Connections are organised between the 3 new groups, by taking more the size of each group into account.

Figure 2. Connexion design in Holstein breed implemented in 2001.



Number on each arrow = number of young bulls whose AI (70 first AI) are sent out of the area of the company belonging to the bulls.

General recommendations implemented in France since 2001

General recommendations have been decided in June 2001 by the National Committee for Animal Breeding (CNAG). The main points are:

- Representativity of the dams sired with young bulls: at least 70% of the first AI must be done with dams in 1st parity. Within parity, the average genetic level of the dams sired with proven or young bulls must be the same.
- Suppression of the incitements given after one test-day. Studies showed also that incitements strongly depending on the age at 1st calving could lead to underestimate the proof of the bulls because very young 1st crop cows were probably not bred in appropriate conditions. Studies on this subject must go on, but an encouragement to very early calving is not recommended.
- A new national design of connection between AI companies has been defined. It has been completed by minimum connection requirements for each bull within a AI company.
- Collect of type data: one technician must not score more than one third of the daughters of a same bull. The name and the identity of the bull must not be known by the technician.

The application of most recommendations is checked each year by Institut de l'Élevage, which sends to each AI company some tables that

summarise the distribution of AI doses of AI bulls, the connection within and between AI companies and some indicators on organisation of scoring.

Most of these recommendations have been already applied by the AI units for many years. Nevertheless, they are very useful because they guaranty a good harmonisation and they are considered as a first step to a quality insurance design for the French practices of progeny test in dairy cattle.

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