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Organisation of sheep breeding in France - suckling breeds - I. General description

L. BODIN
D. FRANÇOIS
INRA SAGA
CASTANET TOLOSAN
FRANCE

Résumé

En France, l'amélioration génétique des ovins est organisée autour de deux ensembles de structures. L'un national et commun à de très nombreuses espèces d'élevage concerne la chaîne de contrôle de performances et d'évaluation génétique (EDE - CRI - CTIG) ; l'autre propre à chaque race rassemble les acteurs de l'amélioration génétique (Eleveurs, UPRA, Centre d'IA, Station de contrôle individuel...). La diversité des races et des systèmes de production explique la grande variété des schémas pour l'utilisation des différents outils qui sont principalement : - Le contrôle de performances en ferme avec plusieurs options dont la plus complète fournit des estimations génétiques des caractères maternels (prolificité, valeur laitière, viabilité des agneaux élevés) et des caractères de croissance des agneaux post-sevrage. - L'insémination artificielle utilisée pour la maîtrise des accouplements raisonnés, l'organisation du testage sur descendance et la diffusion des meilleurs mâles. - Les centres d'élevage (CE) et station de contrôle individuel (SCI) dont les rôles sont d'abord de maîtriser l'origine et la circulation des mâles au sein du schéma puis de contrôler soit le standard et le développement (CE) soit de façon objective les aptitudes bouchères des jeunes mâles (SCI). - Le testage sur descendance pratiqué en ferme pour les caractères maternels et en station pour les caractères bouchers. Les évaluations génétiques basées sur le modèle animal sont faites de façon centralisée pour toute les races (CTIG).

L'évolution actuelle s'applique à introduire dans les élevages des outils informatiques (automate de pesées, carnet d'agnelage informatisé, saisie décentralisée) qui permettent un allégement du système d'enregistrements, une détection précoce des erreurs et une valorisation immédiate de certains résultats. Cependant il faut retenir que c'est surtout la volonté de coopération des éleveurs pour l'utilisation cohérente des outils qui permet de dégager du progrès génétique.

Mots clés : Ovin, sélection, controle de performance, schéma de sélection
Key words : Sheep, selection, recording program, selection scheme.

1. Introduction

Sheep farm production systems and flock management strategies in France are extremely variable. The flocks are generally small ; the global average size is only 107 animals with specialised sheep farms (more than 100 ewes) comprising 58 % of the total flock (compared with respectively 160 ewes and 90 % in the United Kingdom). However, a major feature of French sheep production is the trend towards an out-of-season breeding system which results in a peak in the supply of slaughter animals in April (Spring), diminishing to a trough in supply in November (Autumn). This is the reverse of the traditional European production systems (e.g. in the United Kingdom).

The 7.6 million sheep in France consist of about 40 different breeds, most of which are geographically localised in very small areas. This heterogeneity is useful for maintaining genetic variability and adaptability to cope with diverse environmental conditions, but the small numerical size of each breed imposes limits on the efficiency of the selection schemes, which are developed specifically. The organisation and recording of sheep breeding in France reviewed by Flamant and Elsen (1979), must therefore account for selection programmes which vary greatly in the complexity of breeding objectives and the systems of recording and selection.

2. - Structure of Sheep Improvement

The structure of all livestock improvement in France involves two chains which are linked, and for a large part financed, by the CNAG (Commission Nationale d'Amélioration Génétique), a Commission of the Ministry of Agriculture. The first chain concerns "sets" of selection structures extending from users and breeders to rearing centres, AI centres etc., through to the UPRA (Unité de Promotion de Race). Each set is specific for each species, and for each breed within a species, although the general structure and breeding principles applied are common to all. The second chain in livestock improvement links all the organisations involved in the data processing function. Here, data from all livestock species are collected, checked, recorded, merged with previous data and finally processed. Thus, the following description of the structures of sheep improvement in France could be almost as equally applicable to other livestock species.

2.1. - Selection structures

Each set in the selection structure is breed-specific, and involves the definition, and the realisation of selection.

- UPRA (Unité de Promotion de Race) : Succeeding from the former breed society or flock book, each UPRA determines for each breed the selection objectives and the means by which these objectives can be reached. It controls the Breed file, which gathers pedigrees; breeding values and breed qualifications and produces attestations when needed. Its board gathers together members representing breeders, users (producers, groups, e.g. insemination centres), and the EDE (Etablissement Departemental de l'Elevage). Moreover, representatives of INRA (Institut National de la Recherche Agronomique) and IE (Institut de l'Elevage : the former ITOVIC) are attached to its technical committee. An UPRA (there are about 20 today) may be created for one or several closed breeds by the Ministry of Agriculture advised by the CNAG. Each breed only has one UPRA and hence only one recognised selection scheme.

- Performance Recording Stations and Insemination Centres : fully part of selection schemes, are often independent and can be used by several breeds at the same time. These are considered in more detail when selection methods are discussed in Section 3.

- Breeders are a vital link in the selection process. Their commitment and cooperation is of great importance, particularly when planned elite matings are done, when young rams issued of planned matings are gathered into rearing centres and when sires are progeny tested. However, since breeders are also users, they have to cope with a permanent antagonism between the requirements of the collective selection organisation in a long term perspective and the immediate constraints of their flock management in the current economic situation. Their belief in the collective progress - and their concern - is under responsibility of the selection organisation.

2.2. - Data Processing Organisation

There are several organisations involved in the processing of data, extending from on-farm collection to the estimation of breeding values or indexes (figure 1).

- EDE (Etablissement Départemental de l'Elevage), is a professional regional organisation providing information and advice in agriculture. Its sheep department, in addition to providing advice for all sheep farmers, offers a full recording service and provides the permanent identification (ear tattooing) for farmers involved in a selection scheme. It receives all lists, edits and corrections, links breeders with data processing centres, and despatches outputs. There are 77 EDE in France, having a major responsibility in the processing area for all livestock data to ensure a rapid turnaround of data is met for the benefit of users.

- CRI (Centre régional de l'Information). There are 11 existing CRI which handle all livestock data. They are responsible for data recording and checking, with reference back to the EDE. They can also realize some preliminary calculations (as weights at standard ages) and some summaries (which did not use data recording previously) before sending the standardised information to the CTI.

- C.T.I. (Centre de Traitement de l'Information) is the central headquarters of the national livestock recording board. Here all the data are processed and stored under the control of geneticists of INRA. This huge bank of data provides sample files used in some genetic studies, but generally it estimates breeding values and indexes and provides annual summaries and lists useful for the breeders. In the CTI, Breed data coming from UPRA (Breed qualification) are merged with data from the national recording system (pedigree, individual performances, breeding values...). Some outputs are sent to the breeders through the EDE, but others, mainly those concerning sire indexes, are sent to the selection organisation (UPRA) which decides on the use of these sires. In addition to the technical results and summaries returned back to the breeders, an annual review of results is made by region and by breed. Once a year, the selection schemes are assessed through a data consultation of the national database. These evaluations, which are of great importance for financiers, allow the UPRA to appreciate the efforts provided by the different partners involved in the selection organisation.

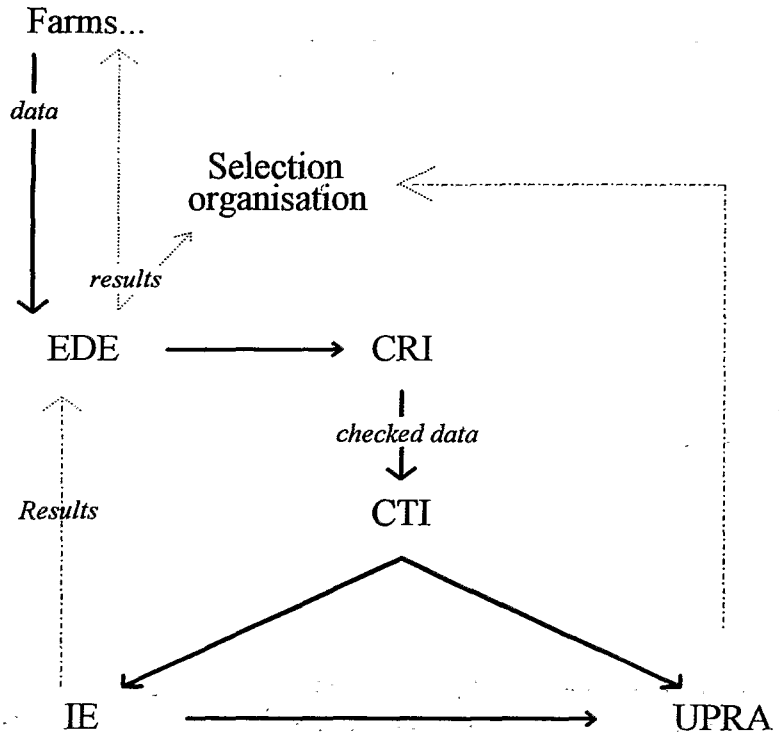

figure 1 : ***Organisations which participate in data recording and processing.***

- IE (Institut de L'Elevage : the former ITOVIC). All the bodies depicted previously are independent but their coordination is ensured within species by a technical institute. Thus, the IE oversees the sheep recording scheme and coordinates all the different activities. It is also implicated in the methodology, the outputs distribution and the provision of technical information to advisers and technicians in the EDE and UPRA organisations.

In common with INRA, the IE determines the selection criteria for each breeding objective and the way these criteria may be recorded and used for genetic evaluation. The introduction of new selection criteria, measurement methods (electronic weighing, fat scanning, etc.), methods for genetic evaluation (e.g. iterative BLUP methodology, animal model) or assessment of selection scheme are studied by IE and INRA.

The provision of technical information to assist advisers and technicians is also an important function of IE if breeders are to appreciate the importance of genetic improvement through accurate performance recording.

3. - Selection Objectives

Selection objectives are decided with breeders by the UPRA. In France, the large variation in selection objectives is dictated by the environmental conditions, mainly climate and soil, which impose different types of feeding systems. Nevertheless, national features enable the presentation of the selection objectives of four major geographical areas.

3.1. - Mountain Area

(Préalpes du Sud - Merinos d'Arles - Pyrénées breeds) : Animals are wintered indoors but graze mountain areas in summer either next to the folds, or a long way away. Mating must take place at precise time (mainly in spring) to avoid births in the mountain pasture in summer and to ensure that the lambs will be old enough to follow the rest of the flock. Maternal ability, fertility in out-of-season breeding, and good adaptation at fluctuating feed supply are then the features required and selected for in the breeds of these areas. Prolificacy enters the objectives, when feeding conditions during winter are good enough to support a prolificacy increase.

3.2. - South of the Massif Central

(Lacaune, BMC, Caussenard du Lot, Limousine, Massif Central breeds). This is one of the regions with the greatest density of sheep. In some cases, sheep farming is the only possible production, but in other situations it has to compete with more profitable production systems through emphasising increased productivity per ewe. Maternal features are consequently given emphasis for these hardy breeds with generally poor meat ability. The main traits selected for, involve litter size, milking ability and perinatal viability. However, several situations have to be considered according to the given priority of each trait. When the environmental conditions are not restrictive for lambing and suckling, litter size and milking ability are given emphasis, but fertility in out-of-season breeding is also regarded as an important objective under accelerated mating systems of three lambings in two years. Such a system offers the additional advantage of adjusting the reproductive period the best fit market demands or to synchronise animal nutritional requirements with the amount of feed available. Improvement of post weaning growth rate and carcass traits are also considered in some situations : breeds with high growth rate potentiality or which have already got enough genetic progress on prolificacy.

For breeds of the mountain areas and south of Massif Central, hardiness is considered as an important feature, although this concept is far to be clear. It might be for each breed, its ability to cope with some aspect of its environments which are famed to be difficult (feeding constraints during winter time, ability to use of ragelands, climatic constraints, parasitism environment...). The genetic variability of such a composite trait is not documented but it is admitted that selection for hardiness is included in selection of production traits expressed in those specific harsh environments

3.3. - Pastures of the West Coast

(Avranchin, Cotentin, Bleu du Maine, ...). In these regions, where sheep co-exist with cattle, the feed requirements of ewes and lambs are satisfied at spring with the abundant pasture growth but lambs have to be sold before the summer period to leave pasture for the cattle. In this content, sheep have to be highly productive to compete with cattle, and numeric productivity is obviously desired, but lamb growth on pasture, conformation and carcass quality are also required.

3.4. - The Industrial Crop Area of the Parisian Basin and other proven breeds

(Ile de France, Berrichon, Texel, but also Vendéen, Rouge de l'Ouest, Charollais). As there are possibilities for intensive and abundant nutrition in autumn and winter, in this region, the breeds have been selected for a long time for meat purpose and are the so called "proven

breeds" which produce lambs in sheds in out-of-season breeding. As for the pastures of the Atlantic coast, the rich feed conditions allow emphasis on meat production, in addition to the general maternal ability. For their abilities, these breeds are also used as terminal crossing sire breeds for lamb production or they are exported, leading to pure-bred flocks with emphasis on meat traits.

3.5. - Other objectives : Wool

Apart from some breeds (different breed of Merinos, Ile de France), French sheep have poor wool productivity and in many cases, the shearing cost just balances the financial returns from wool (Rougeot, 1985). Wool is therefore rarely an objective of selection, although most breeds consider fleece appearance in their breed standards, culling spot-fleeced or hairy animals and those with too much (or not enough) cover on the faces and legs.

Even the French Merino breeds and Ile de France breed, which are famous for their fine-wool, have not included any objective wool measurements in their selection criteria. Fleece standards are maintained by eliminating the worst-fleeced animals during the culling period before breeding. Although other traits are also considered at the time of culling, quality seems to be kept.

4. - Selection Tools

There are two inter-dependent steps essential in a selection scheme : first, selection of animals for breeding based on genetic values ; then, dissemination of genetic progress through the largest use of the best breeding animals detected at the previous step. These two steps use several tools, the number of which and the way they are linked, determining the kind of selection scheme and its efficiency.

4.1. - Performance Recording on Farm

Since its establishment about 30 years ago, the recording of performance for meat purpose sheep was conceived on farms to supply management and technical information and to provide data for sheep improvement. It concerns the lifetime reproduction of suckling ewes and the growth rate of their lambs in order to estimate the genetic value of the animals recorded. It considers what can be readily on farm recorded and integrated in the national computer process. Therefore, traits which are difficult to measure, as hardiness or out of season breeding fertility, are still not included.

The most basic information comes from data on ewe lambings (date, litter size, etc.), the maternal pedigree and some rearing status (artificial or maternal rearing, rearing rank, adoption...) of each lamb born. Lambing control is completed by data reproduction (date of joining, mode of oestrus : induced or not, etc.) allowing the assessment of ewe prolificacy and fertility. According to the needs of each breeder and the selection requirements of the scheme, this reproductive control can be completed for each lambing group (all lambs born in 42 day period) by either three or five weighings spaced 21 days apart starting three weeks after the first lamb is born.

The two first weighings of each lamb are registered to estimate the lamb growth rate between 10 and 30 days of age and predict indirectly the dam milking ability, while the later weights estimate lamb growth rate between 30 and 70 days of age.

Sire identification requires individual mating sire groups or artificial insemination, although the latter option does not avoid mob-mating on the oestrus following the induced oestrus.

4.2. - Data processing

French genetic evaluation does not go beyond the assessment of individual trait breeding values. Moreover, they are mainly estimated by univariate statistical methods (Poivey et al., 1990 ; Poivey et al., 1994), although for some traits two variates are computed together (e.g. natural litter size breeding value is assessed from natural and induced litter sizes, milking ability is assessed from pre-weaning growth rate and lamb mortality). For each animal, all breeding values with their accuracies are printed at CTI and sent to the UPRA (generally prolificacy, milking ability and sometimes 30-70 day growth rate). There are more breeding values when carcass measurements are made. This policy stems from the difficulties to obtain accurate genetic correlations among traits for each breed and relative economic values, that each trait should have in an index.

Today an iterative BLUP technique on an animal model copes with the large number of reproducers to index each year for each breed. It furnishes the best predictors taking into account for each animal all the information of its relatives and all its pedigree (dam, sire, daughters, half sibs, etc.).

4.3. - Nucleus Flocks

At the present time, the use of nucleus flocks in France, is only justified where the population size is very low, the breed is in maintenance and the nucleus flock is closed : Merinos de Rambouillet flock. The former nucleus flock of the INRA 401 breed has been opened for its dissemination and the on-farm selection of this synthetic breed.

4.4. - Insemination Centres

In France, the individual use (vs. use in collective selection organisation) of artificial insemination (AI) has a dual purpose.

- As a reproductive technique, it has a vital role in out-of-season breeding, e.g. avoiding problems of out-of-season fertility of rams, and exploiting the opportunity to use synchronisation of oestrus without increasing the number of rams. In 1993, about 119 000 meat ewes were inseminated with such a purpose.
- As a genetic improvement technique, interest is taken in the higher potential value of the progeny either for slaughter or for breeding (about 165 000 for meat ewes in 1993).

But AI is also used by collective selection organisation in three essential steps :

- Any breeding scheme will be efficient if each year the best ewes are mated with the best rams in order to produce the next generation of sires. These "planned matings", easier when using AI, are essential to ensure that genetic progress can be accumulated through each generation. AI also allows to control matings, especially in small flocks with few elite ewes located throughout a region.
- AI permits to reduce the number of rams used and to increase the dissemination rate of each one, thus it allows to obtain an increase of the selection intensity and

therefore of the genetic progress.

• The assessment of genetic merit can be improved by using AI, depending on the number of inseminated ewes in the population. When their number is low, the AI can be used to improve the statistical design, allowing an estimation of flock effects and a comparison of reference sires with sires used in natural matings. When the number of inseminated ewes is high, AI can be used to organise progeny tests. In this case, there is then a triple advantage over natural matings : better accuracy of progeny-ram links and easier management and control of matings ; increase of family size and thus the accuracy of index ; better dissemination of rams among flocks for assessing and correcting the fixed effects.

4.5. - Recording Stations

There are two sorts of central performance recording stations for young rams.

- Rearing centres (RC) : These stations are an essential element of a selection scheme by their important role of mastery of sire origin and dissemination. Young rams issued from planned elite matings are selected at 2-3 months of age and reared together in a common environment. Those with poor performance or with breed defects are culled after an initial rearing period. After this step, according to the selection practised on ancestry value, individual performance or progeny test, the rams are disseminated within the scheme between the breeders, out to the remainder of the population, or they are directed towards an insemination centre for progeny testing. There is no veritable selection and the proportion of rams kept for breeding is generally high.

- Individual Performance Recording Stations (IPRS) : These stations have the same essential role of mastery of sire gathering and dissemination, in addition, the individual performances recorded allows a real objective individual selection. Comparing to on-fam recording, these stations allow a better environment control (feeding system, slaughter conditions) and then a better expression of genetic differences between candidates (Perret et al. 1994). They also permit precise measurements. Young rams are selected at 2-3 months of age and after a two week period of adaptation, they are fed ad libitum for eight weeks with body growth, conformation and fatness being recorded. At this level of feeding, genetic differences are expected to be fully expressed - for the benefit of ranking the individual rams. Fatness is now recorded by ultrasound scanning, which has shown a close relationship with fat recorded at slaughter. After this period of ad libitum feeding, which is not applicable for future reproducers, the rams are generally exposed to another adaptation period before being disseminated, sold or culled at about seven months. Simulations programmes have shown that the higher genetic progress is achieved when about 50% of the rams are selected for the following step.

As most of meat traits presents high heritability, individual selection of young rams is particularly efficient. Therefore these stations appear to be an essential element for the meat purpose sheep breeds, and 15 of them have such a station. Recently an individual evaluation programme using the BLUP has been developed for the rams. It combines the on farm data with those recorded at the station and provide breeding values for growth rate, fatness, conformation as well as a synthetic breeding value.

4.6. - Progeny Testing Stations

It is necessary to distinguish two types of progeny testing stations according to the selection objective : ewe fecundity or meat purpose. The first type of station originally involved two flocks, the dam flock mated each year with rams under test, and the progeny flock lambing once or twice before sire genetic evaluation and culling. Given the high cost of such a station, limited flock size restricts the number of rams that may be tested. In addition, the need for a dam flock disappears with the facilities offered by AI, which in turn permits an efficient progeny test to be conducted on farms. Such progeny testing stations have disappeared in France.

Progeny testing for meat production is carried out at Berry-Test, which is a multi-breed progeny testing station (Bouix et al. 1982). Here sires of meat purpose breeds issued from individual recording stations of each breed (9 breeds ; 10 sires per breeds) are mated (by insemination) to Romanov-Berrichon cross ewes. Progeny (30 lambs per sires) is measured for body growth and latter carcass performance. A great number of variates are recorded at slaughter for genetic assessing on butcher features. After processing by the CTI, the evaluation results are despatches to the different breeds which qualify the sires.

Another kind of station for progeny testing concerns the original scheme for the Lacaune meat purpose breed (Gebro). Dairy ewes are inseminated in dairy farms by about 40 young rams under test. Lambs are gathered together at weaning at about one month and are fattened indoors . Records collected during this period and carcass measurements taken at slaughter serve to estimate the breeding value of sires. Testing meat purpose sires on the dairy breed ewes carries a great deal interest for both populations : the dairy producers can sell crossbred lambs after weaning, which have a higher growth potential, and the meat sheep breeders may test a great number of young rams and only use the elite rams in their flocks.

5. - Existing Selection Schemes

All the recognized breeds do not have an organised selection scheme, and among those existing schemes not all of them are using all the selection tools available.

The simplest schemes (Southdown, Berrichon de l'Indre), consist of within flock selection for future rams and ewes according to the required features determined by the UPRA. In these cases, the breeder chooses his young rams and presents them to a commission of the UPRA for agreement. This is not strictly a selection scheme and the rate of genetic improvement is not expected to be high.

Most other schemes use a rearing centre (RC) or an individual performance recording station (IPRS). In these cases, the organisation of selection follows the information on the sires, from which selections can be made taking into account their dam performance from the national recording scheme. There is really a common objective of selection and breeders can buy (from the RC or IPRS) the best sires of the breed and use them over their best ewes. However, this kind of scheme is much more efficient as soon as an AI centre exists to organise the planned matings between the very best sires and elite ewes to produce the next generation of rams, and to disseminate the genetic progress made. In fact these two activities in association with rearing centres constitute the keystone of all selection schemes in France, and has priority in the official politicy of French sheep improvement. Most of breeding schemes

involve at the present time, an individual performance recording station, hence a real selection of post-weaning growth rate can be applied from objective measurements.

Although there are few schemes developing a real progeny test for maternal ability, different models can be found, nevertheless the trend is to implement progeny testing exclusively on farms. Then AI is used to avoid the sire-flock confounding effect and to improve the accuracy of indexation of sires serving naturally within the flocks (Ile de France, BMC, Vendéen, etc.). However, in some cases progeny tests are based exclusively on AI (Lacaune). In fact, in these populations, oestrous induction and synchronisation treatments are already massively used to ensure fertility in out-of-season breeding, with AI services used routinely.

Progeny testing on stations are undertaken for meat traits.

6. - Conclusion

Faced with the great diversity of sheep production systems, French selection schemes organisation comprise the same structures and use common tools, but the manner in which these aspects are used and combined, leads to a great diversity of schemes. However in this context improvement of any selection method modifies the efficiency of all schemes using it. In particular two ways are today undertaken :

6.1. - Recording simplification

Even if the constraints of the recording are balanced by the individual and collective interest of the results provided, there is a degree of breeder resistance to recording because of the tedium of repeated weighings, the high costs of recording and the slowness of response time. The current trend is to simplify the recording and to accelerate data turnaround. Electronic scales linked to micro-computers are used to check the data and to supply an immediate first-summary. Electronic lambing book is also implemented in some flocks. This small computer is loaded at the beginning of the campaign with the ewe stocklist. It avoids miss-recording at lambing and accelerate all the process of data transmission.

6.2. - Animal model

Adoption of an iterative BLUP technique on an animal model for the breeding values evaluation provides, a higher accuracy of sire and dam genetic values in taking account of environmental effects and all the relationships between animals.

Most important of all, genetic improvement realised in commercial flocks in France depends on the commitment and cooperation of the ram breeders. The greatest increase in selection efficiency always will come through better breeder cooperation in sharing rams, using AI, breeding the progeny and merely maintaining the guidelines that they themselves have laid down.

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