H1.15 Efficiency of past selection of French Sport Horse: the Selle Français and suggestions for the future

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ABSTRACT

The genetic gain for show jumping and the evolution of genetic variability between 1974 and 2002 for the Selle-Français (SF) population are presented. The three parameters of genetic gain: the intensity of selection (*i*=1.95 for males, 0.56 for females), the accuracy (*r* =0.71 for males, 0.57 for females), the generation interval (*T*=12.9 years sire/sire; 10.4 years dam/sire; 12.1 years sire/dam; 11.4 years dam/dam); and the practice of breeders who choose preferentially the best stallions (i=2.2 weighted by the number of covering) but also stallions selected on their progeny (50% of covering) explain the efficiency of the existing breeding scheme for the show jumping and the possibility of improvements. For the males, to increase *i,* we should use the effective selection rate (1.7%); and to reduce *T*, we should use the young stallions and reduce the age of reform. For the females, to reduce *T*, we should help the young mares (4 and 5 years old) to go back to breed. Although the inbreeding rate increases in 30 years (it is now equal to 1.4%), it is not worrying. If we keep the same structure (test of stallion on their own performance), it is possible to add new criteria (conformation, gaits…) in the breeding scheme for SF and to conserve the genetic gain (1.1 points on BSO/year).

1 INTRODUCTION

The Selle-Français (SF) was mainly selected for the show jumping. The French breeding scheme contains a lot of rules. They are function of the age of the candidate and there are different ways to become an approved stallion. A 3 years old candidate should pass a gaits and conformation test. Then at 4, 5, 6 years or more the candidates are selected with breeding evaluation or phenotypic evaluation or with performances and an examination by a special commission. Whatever, the age of selection all the approved stallion have pass an X-Ray test. But was this selection effective for jumping? What were the consequences on the other disciplines: the dressage and the eventing? For the future, the stud book would like to multiply the criteria of selection: in addition to the show jumping, they would like to selected horse on the gaits, conformation, health…. To add all these criteria by keeping an effective breeding scheme, it is initially necessary to identify the qualities and the drawbacks of the current plan of selection. For all these reasons, we drew up the inventory of fixtures of the selection of the SF over the 30 years spent, without forgetting to check where is the consanguinity and the management of genetic variability.

2 MATERIEL

2.1 Genealogical data

The data used was provided by the national horse register, "Système d'Identification répertoriant les Equidés (SIRE from the Haras Nationaux., This file included all the Selle Français (SF) born from 1974 to 2002 (figure 1) and their know ancestors. This file contained for each horse registered all this information: an identification number (ID), the name, the sex, the breed, the date of birth, the ID number of sire and dam.

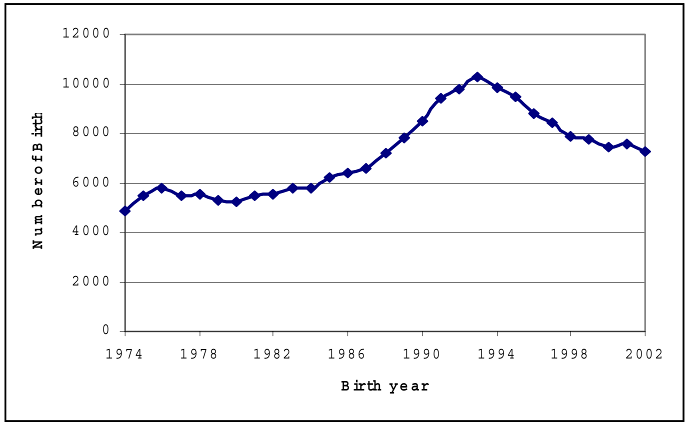


Figure 1: Evolution of the SF birth between 1974 and 2002

This file contained 314564 horses including 222978 SF. The information was complete except for the date of birth that was missing for 2.8% of the horses. These horses were horses for which one or two parents are unknown (92%) and 46% of horses with one unknown parent had a missing date of birth.

Considering the most recent cohorts of offspring, the pedigrees were found complete up to the fourth generation. Up to the seventh generation, the proportion of know ancestors was more than 50%. For offspring born in 1974, the proportion of know ancestors was 50% from the fifth generation onward.

The SF was the product of a long selection process that has developed during the 20th century. First, it was called "demi-sang" and was the progeny of Thoroughbred stallions and local breeding mares. It was only in 1958, that the name Selle-Français appeared. Between 1958 and 1994, the stud book was open and a lot of crossings were possible. The decree of January 1995, closed partially the stud book and only the progeny with at least one parent SF could be recorded on the SF stud book. In 2002, the crossings represented 13% of coupling: 2% with Thouroughbred, 4% with Anglo-arab and 6% with foreign sport horse.

2.2 Breeding evaluation

Since 1989, horses had a genetic evaluation for the jumping based on the animal model and this evaluation is called BSO for the jumping.. This evaluation was provided from the criterion of the logarithm of the annual earnings of the horse since 1972, to which was added the criterion of the underlying performance responsible for ranks since 1985. The logarithm of annual earnings followed a traditional mixed model, it had a normal distribution and the fixed effects were the sex and a combination of the age and year of performance. The random effect were: a common environmental effect to the different annual performances of the same horse, a common environmental effect to the performances of the different descents of one mare (maternal effect) and an effect of additive genetic value. The underlying performance responsible for ranks followed a mixed model. The fixed effects were the sex and the age of the horse, the environmental effects common were the same ones as for the annual earning criterion. Covariance between the environmental effects common of the two criteria were considered. The parameters used were as follow: Heritability was 0.27 for Log(annual earnings) and 0.16 for underlying performance responsible for ranks in every events. Repeatability was 0.47 (between years) and 0.29 (between events) respectively. Herd-maternal effects represent 5% and 3% respectively. Genetic correlation between the two traits is 0.90, like was the correlations between common environmental and maternal effects for the two traits. (Ricard A., 1997)

Since 1999, horses had also breeding evaluation for the dressage (BDR) and eventing (BCC).

2.3 Phenotypic evaluation

The Phenotypic evaluation was called « Indice de Performance ». It represented an annual evaluation of the performance of the horse corrected for fixed effects. It combined the two traits annual earnings and « ranks » in the same proportions. The accuracy was given with each evaluation as a « Coefficient de Détermination » (CD) equal to the square of the correlation between true sporting value of the horse and its estimation.. Each horse which had participated to an event had a phenotypic evaluation, even if it never earned any money. Since 1974, horses had a phenotypic evaluation for jumping. (Ricard A., 1997)

In 2002, 28888, 2650 and 2109 SF horses had a phenotypic evaluation for jumping, eventing and dressage respectively.

3 METHOD

3.1 Measure of genetic gain

The realised genetic gain was computed as the average of genetic evaluation in function of the birth year of the SF population.

3.2 Study of the three parameters of genetic trend

The annual genetic gain is given by (Rendel and Robertson, 1950) :

$$\Delta G = \frac{i_{SS}r_{SS} + i_{SD}r_{SD} + i_{DS}r_{DS} + i_{DD}r_{DD}}{T_{SS} + T_{SD} + T_{DS} + T_{DD}}$$

with
S for Sire and D for Dam
i: the intensity of selection
r: the accuracy
***T*:** the generation interval

The three parameters in each pathway were studied. Due to the long generation interval and the relatively low history of breeding value, the calculation on the four paths was often difficult: we had to wait for a progeny to become parents to distinguish sires of sires and sires of dams. So, calculations on sire/progeny and dam/progeny paths were also performed.

The data used to compute these parameters were censored in the left hand side because the breeding values were available only since 1989 and so, horses selected before this date had no breeding evaluations. This data is also censored in the right hand side because only reproducers with progeny in the file are known as sires or dams and the age at first progeny is variable. So for a generation of horses, the final number of horses selected to become parents is known very late. So, in addition to the 4 paths ways studied, the path sire/progeny and dam/progeny were also computed.

The parameters of genetic trend were calculated according to the birth year of the parent, the birth year of progeny and age of parent in order to have a complete view of the system as a longitudinal study or cross-sectional study. In each case, the number of horses for which the estimates of selection intensity, reliability and generation intervals was available has been given according to the data available for pedigrees and breeding evaluation.

The results were also given weighted with the number of progeny. The results were distinguished according to the breed of the reproducers as parent of SF.

3.2.1 The intensity of the selection

3.2.1.1 Definition

The intensity of selection was the average of the genetic superiority (sup) of the horses considered. The genetic superiority was given by:

$$\text{sup} = \frac{\text{Breeding Evaluation} - \mu}{\sigma}$$

With:
Breeding Evaluation = The breeding evaluation of the selected horse the years of the selection (i.e. two years before the birth of its first offspring)
μ = The average of breeding evaluation of the year of selection of the SF horses born the same year as the selected horse
σ = The standard deviation of breeding evaluation of the year of selection of the SF horses born the same year as the selected horse

The intensity of selection had a normal distribution so it was possible to associate a theoretical rate of selection by truncation of the distribution.

$$i = \frac{z}{p}$$

With
i: the intensity of selection
z: ordinate of the distribution at the point of truncation
p: the theoretical pourcentage of selection

3.2.1.2 The stage of selection

The first stage of selection was selection on ancestors and relatives and eventually performance. This selection has been performed on the breeding value calculated 2 years before the first births of progeny. The second stage of selection considered was on progeny results. First results in competition took place at 4 years old. So this selection was performed on the breeding value calculated 4 years after the first births of progeny and progeny resulting from this selection were born 6 years after the first generation. The figure 2 shows repartition of birth in function of the stage of selection and the age of stallions for the SF born in 2001 and 2002.

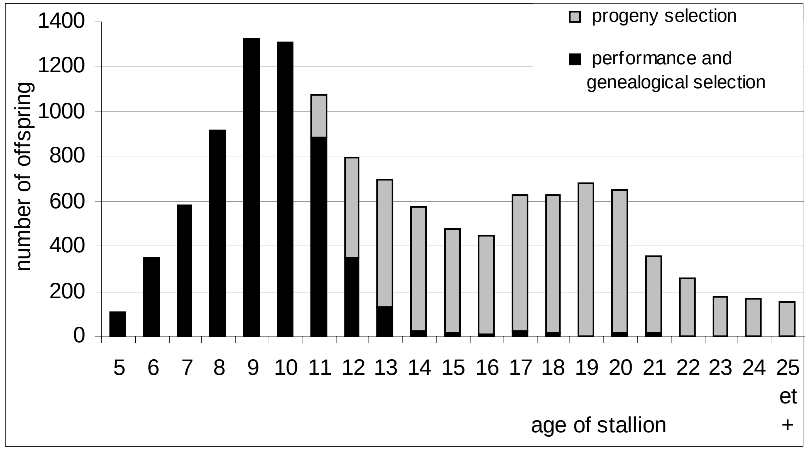


Figure 2: Distribution of birth in 2001-2002 according to the age of stallions and the stage of selection

3.2.1.3 The studied population.

The intensity of selection was possible to estimate only from the births of 1991. Horses born before were born from parents selected before 1989, so before any breeding evaluation. The percentage of horses with a known intensity of selection on their sire increased from 10% in 1991 to 71% in 2002 with a stabilisation around 70% from 1998. The percentage of horses with a known intensity on selection on their mare increased regularly from 30% to 92% from 1991 to 2002. The number of horses born during the period 1991/2002 which had time to become stallions was about 80 in 1991-1993 and felt to 4 in the last year available: 1997. On this sample, 13% of the intensity of selection of their sires and 45% of the intensity of selection of their mares were known. On the pathway sires of dam and dam of dam, the percentage of known intensity of selection started respectively at 8% and 24% and reached 60% and 70% in 1997.

3.2.2 The accuracy

The accuracy was computed as the square root of the CD which accompanied the genetic evaluation when the horse is selected. The same proportion of reproducers than for the intensity of selection was concerned.

3.2.3 The generation interval

3.2.3.1 Definition

Generation lengths were computed as the average age of parents at the birth of their offspring. The generation intervals were computed on the four pathways (sire-sire, sire-dam, dam-sire and dam-dam) but also on the ways sire-progeny and mare progeny because of the censured data.

3.2.3.2 The studied population.

The maximum age with the birth of the first product for the mares is 20 years and the minimum 3 years so it was difficult to provide statistics on complete cohorts. In average, 54% of mares became broodmare and at the age of 15 almost of the broodmare was declared.

3.3 The genetic analysis

The analysis of genetic variability used the PEDIG software (Boichard D., 2002; http://www-sgqa.jouy.inra.fr/diffusions/htm) and personal programs.

3.3.1 The breed composition

A gene randomly sampled at any autosomal locus of a given animal had a 0.5 probability of originating from its sire, and 0.5 probability of originating from its dam. Similarly, it had a 0.25 probability originating from any of the four possible grandparents. This simple rule, applied to the complete pedigree of the animal, provided the probability that the gene originates from any of its founders (James, 1972). A founder was defined as an ancestor with unknown parents. By using these probabilities, it was possible to calculate the breed composition. In fact, a given horse had 50% of its genes originating from the breed of its sire (provided by its sire) and 50% of its genes originating from the breed of its dam (provided by its dam). Then, the breed composition was calculated by:

$$\text{Breed composition} = \left(\frac{1}{2}\right)^a R_{fa} + \left(\frac{1}{2}\right)^b R_{fb} + \ldots + \left(\frac{1}{2}\right)^n R_{fn}$$

With:
a, b, …, n: The number of generation between the considered horse and the founder a, b,…, n respectively
R_{fa}, R_{fb},…, R_{fn}: The breed of the founder a, b, …,n respectively

3.3.2 The inbreeding rates

Coefficients of inbreeding were computed for all the animals in the file, using the algorithm proposed by Quaas (1976). In order to distinguish close and remote inbreeding, these coefficients were computed for successive values of the number of generations of ancestors considered and for the total pedigree information available.

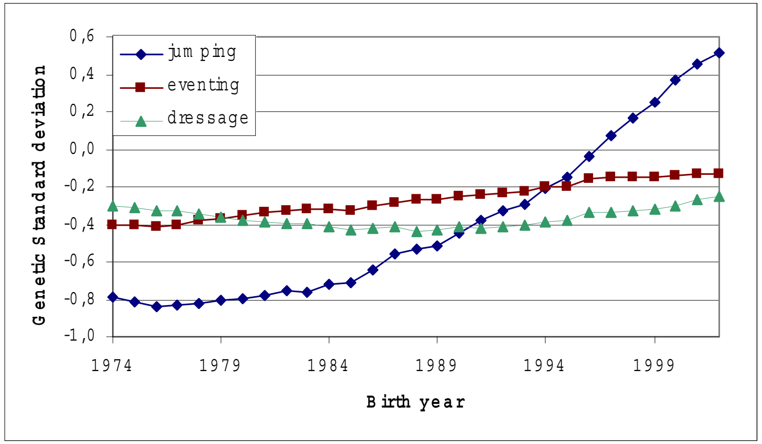
3.3.3 The major ancestor

The major ancestors (founders or not) were detected using the method proposed by Boichard *et al.*, 1997). Ancestors were chosen on the basis of their expected genetic contribution. However, as these ancestors may not be founders, they may be related and their expected contribution could be redundant and may sum to more than one. Consequently, only the marginal contribution of an ancestor, ie, the contribution not yet explained by the other ancestors, should be considered. The ancestors contributing the most to the population were chosen one by one in an iterative procedure. The first major ancestor was found on the basis of its raw expected contribution. At round n, the *nth* major ancestor was found on the basis of its marginal contribution defined as the genetic contribution of ancestor k, not yet explained by the n-1 already selected ancestors.

4 RESULTS

4.1 The genetic gain

Figure 3 shows the genetic gain realised between 1974 and 2002 for jumping, eventing and dressage. For jumping, there are three different phases. The first one, between 1974 and 1985, in which there is no progress (0.7% of genetic standard deviation/year). In the second phase between 1985 and 1995, the progress increase and it is about 5.6% of genetic standard deviation/year. During the last phase, between 1995 and 2002, the genetic gain is high (9.6% of genetic standard deviation/year). For eventing, we get a small progress (1.1% of genetic standard deviation/year) and for dressage, we observe any damage (0.2% of genetic standard deviation/year).



<u>Figure 3 :</u> The effective genetic gain in jumping, eventing and dressage

4.2 Study of the three parameters of genetic gain

4.2.1 Intensity of the selection

For the SF mares, the intensity of selection is 0.56 that is equivalent to a theoretical percentage of selection of 66%. For the non-SF mares, parent of an SF, the intensity of selection is -0.59.

For the SF stallion, all the results for the intensity are presented on the table 1. The number between is the theoretical percentage of selection.

	First intention	Weighted by the number of their offspring
Ascent and performances selection	1.95 (6.5%)	2.21 (3.5 %)
Progeny selection	1.95 (6.5%)	2.76 (0.8%)

Table 1: Intensity of selection in function of the stage of selection for the stallion

For the non-SF stallions, parents of an SF, the intensity of selection is equal to 0.31.

4.2.2 The accuracy

For mares, the accuracy is 0.56. 46% of them have performances and more or less 25% have gaits and conformation test

For stallions, the accuracy is 0.67 after genealogical and performance selection and 0.74 after progeny selection

4.2.3 The generation interval

The table 2 give, the generation interval (calculated by the mean of age of parent of broodmares and stallions) on the 4 pathway in function of the breed of the parents and the progeny. The sire way is longer than the dam way. The non-SF parents extend the generation interval particulary on the sire/sire way.

	Sire/ Sire	dam / Sire	Sire / dam	dam/dam
SF-SF	12.9	10.4	12.1	11.4
Non SF - SF	20.1	12.4	13.8	11.9
SF - non SF	12.3	10.5	12.6	11.5

Table 2 : Generation interval of the 4 paths : mean of age of parent of broodmares and stallions born from 1991 to 1994

The table 3 shows the evolution of the interval of generation between 1991 and 2002.

	Sire / progeny	Dam/progeny
1991-1994	11.7	11.3
1999-2002	12.8	11.8
2002	13.5	11.8

Table 3 : Generation interval of the SF population: mean of age of parent of 3 cohorts of SF (1991-1994, 1999-2002, 2002)

4.3 The genetic analysis

4.3.1 The breed composition

The SF had 50% of Thoroughbred (Th) genes and 33% of "demi-sang" (DS) genes (the old name of the SF). The 17% remainder was an equal proportion of Trotteur français (TF), Arab(Ar), Foreign sport horse(FSH), Anglo-Arabe(AA), and Unknown Origin(UO) (figure 4). So, the SF had at least 50% of Thoroughbred gene because the "demi sang" was the progeny of Thorougbred stallions and local breeding mares, unless against selection of these genes did not take place during generations. The recent evolution of the couplings showed a decrease of the crossings with the Thoroughbred (< 2%) and a total abandonment of the Trotteur-Français which are replaced by the Foreign Sport horse whose growth was exponential (6% of the births in 2002).

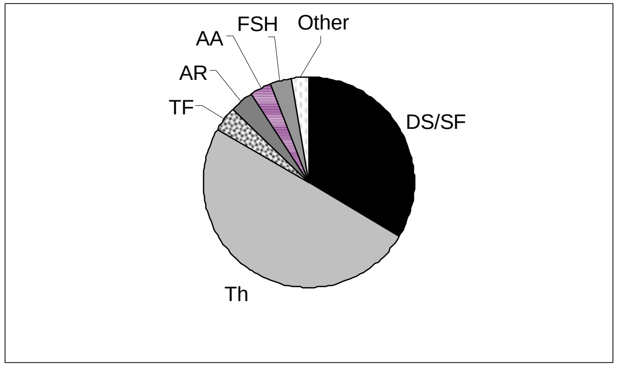


Figure 4 Breed composition of the SF population born from 2000 to 2002

4.3.2 The inbreeding rate

The figure 5 shows the evolution of the coefficient of inbreeding and the proportion of inbreeding horses between 1974 and 2002 for the SF population. The increase was regular between 1974 to 1992 at the rate of 0.02% per year: the inbreeding rate passed from 0.3% to 0.7%. Then, the increase accelerated clearly until 1998: the growth was about 0.08% to per year and the inbreeding rates reached an average of 1.2% in 1998. Then, the increase slowed down to return at intervals of 0.03% per year. In 2002, 100% of the SF are inbreeding and the inbreeding rate is 1.4%.

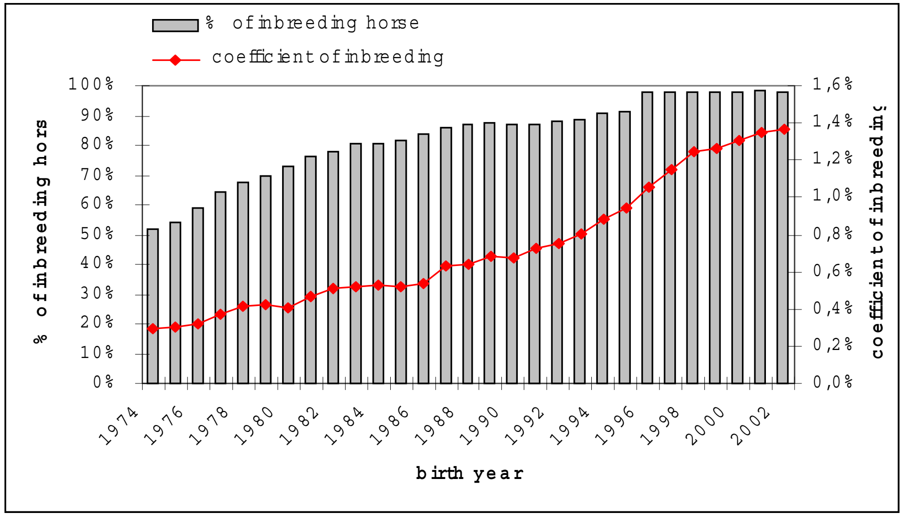


Figure 5 : Coefficient of inbreeding in the SF population born from 1974 to 2002

The figure 6 shows the evolution of inbreeding and the proportion of inbreeding between 1974 and 2002 for a determinate number of generation: (4 and 6) of ancestor considered. The evolutions are similar of the evolution with no limited generation but the rate and the percentage are lower. In 2002, 30% of the horse are inbreeding at the 4th generation and 80% at the 6th generation. The inbreeding rates are respectively 0.6% and 1.2%.

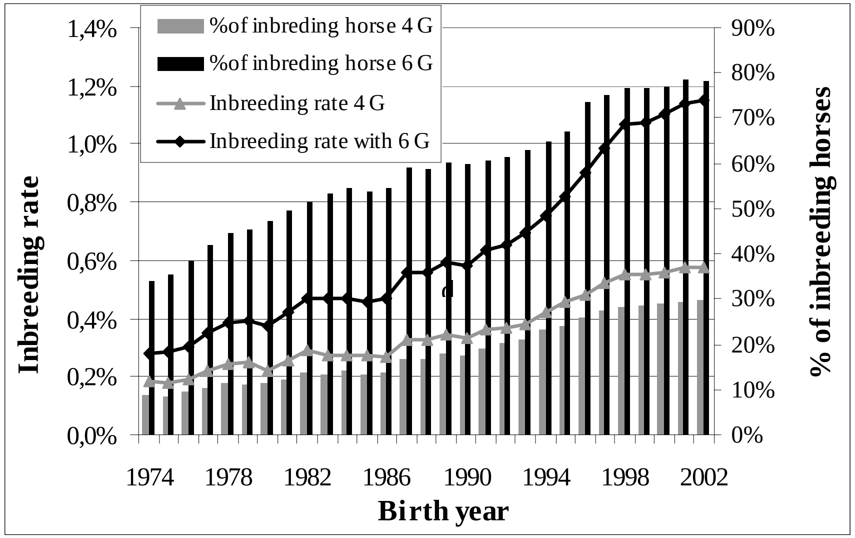


Figure 6 : Coefficient of inbreeding in the SF population born from 1974 to 2002 for 4 and 6 generations (G) of ancestors considered

4.3.3 The major ancestor

The table 4 introduces the 16 ancestors which contribute to more than 1% of current population SF.

NAME	Birth year	Breed	Rank as major ancestor	% of gene of which it is responsible as a major ancestor
IBRAHIM	1952	SF	1	8,7%
ULTIMATE (IE)	1941	PS	2	4,5%
URIEL	1964	SF	3	4,4%
GRAND VENEUR	1972	SF	4	3,9%
FURIOSO (GB)	1939	PS	5	3,8%
RANTZAU	1946	PS	6	2,3%
ORANGE PEEL	1919	PS	7	2,3%
FRA DIAVOLO	1938	PS	8	2,1%
GIRONDINE	1950	SF	9	1,6%
LAUDANUM	1967	SF	10	1,5%
CENTAURE DU BOIS	1946	SF	11	1,3%
DENOUSTE		AR	12	1,2%
NARCOS II	1979	SF	13	1,1%
PLEIN D'ESPOIRS	1937	SF	14	1,1%
NIGHT AND DAY	1957	PS	15	1,0%
VITI	1965	TF	16	1,0%
JUS DE POMME	1931	SF	17	0,9%

Table4 : Major ancestor of SF born from 2000 to 2002

IBRAHIM (born in 1952) is responsible for 8.7% of genes of current SF. UTLTIMATE (IE). FURIOSO(GB), RANTZAU, ORANGE PEEL and FRA DIAVOLO (born between 1919 and 1946) are all 5 in charge for 15% of genes for today. With the two big stallion from 1970's: URIEL and GRAND VENEUR , we finally adds up with this 8 ancestors 1/3 of genes of the current SF. In fact, thus the reproducers contain these origins which diffuse them now, and they are too numerous so that they are quoted all. We can add the new bottlenecks to them which are NARCOS II, VITI and consequently GALOUBET A, VOLTAIRE (DE), COUNT IVOR, EOLIENNE (consequently ROSIRE), MUGUET DU MANOIR , VENUE DU TOT (consequently LE TOT DE SEMILLY and LE PLANTERO). Also, we notice that if the principal bottlenecks are due to stallions, some brood mares, mothers or grandmother of several stallion, make of it also party: GIRONDE mother of ALME and grandmother of QUASTSOR, or GAZELLE mother of DIGNE ESPOIR, grandmother of DOUBLE ESPOIR, QUEL TYPE D'ELLE, REVE D'ELLE and great-grandmother of BAYARDD'ELLE.

5 DISCUSSION

5.1 Forces and weaknesses of the current breeding scheme for the show jumping.

The intensity of selection in first intention, i.e. if it is calculated on the genetic value of the approved stallion, independently of their respective use, is only 1.95, at the stage of the selection on ascent and performance and also at the stage of the selection on progeny. That means, the selected males are on the 6.5% best stallion at the first stage and then all pass successfully the test on progeny. This is very far from the demographic possibilities. To keep 6.5% of males is equivalent to choose 1 male out of 15, and if we go up with the number of covered necessary to have 15 males tested in competition, 111 coverings are enough under the current breeding scheme. 1 year of reproduction would be sufficient to choose the substitute of a stallion. We are moreover very far from the rate of selection really applied, which is 1.7%. The choice of the stallion is dramatically ineffective. In fact, this heavy report is balanced by the practice of the breeders, independently of the initial choices. When the value of the stallions is balance by the number of their offspring, the intensity reaches 2.21 at the first stage of selection, that means a theoretical rate of selection of 3.5% and 2.76 on progeny, is a rate of 0.8% (1 stallion out of pass the test on the progeny) and even 3.01 these last years (10% only of the stallions are selected on progeny).

An important improvement would be already carried out by applying a strict selection of best the 1.7%, therefore by keeping the number of currently selected stallion SF and by making them reproduce equally. The intensity of selection would be 2.48 (+0.27). The second stage would be to use the demographic possibilities. It is not unrealistic to count on 600 coverings carried out over the 6 years that waiting of the test on progeny, with a fertility of 55%, a sex-ratio of ½ and 50% of the births tested on show jumping, without counting a pre-selection on ascent, 83 males could be selected by stallion, and a rate of 1.2%. The intensity is then 2.60 (+0.39). If the 165 males born constitute the base of selection, the rate falls to 0.6% and the intensity climbs to 2.83 (+0.62).

The recent use of the selection on progeny (in the end of 1990) is a good thing. But it should not make forget the improvement of the first sorting, which, if it was well done , should not lead to such a low rate of stallions kept after the test on progeny (at least according to the number of products, not by the real elimination of the stallion). The optimum mentioned in the optimization carried out by Tavernier and Clerc (1994) recommended a rate of 1/3. It was shown that in the generations the 2001-2002 half of the products resulted from stallion known on progeny. The distribution of the average age of the fathers of these generations shows the same thing, with a significant disaffection for the stallions from 6 to 8 years at the birth of their offspring. The optimum recommended by Tavernier and Clerc was 15% of the covering carried out by the standards tested on descent. This situation is due to lack of rigour noted in first sorting, (we note a fall of the intensity in 2002) which results in referring on sour values, and could be also with a lack of policy of development of the young stallions performers. To improve this policy, we could imagine a better pricing policy, advantages related to the use of these stallions or a better description of their potential inciting.

On the female way, for mares SF, and in the absence of any policy, the selection is quite real, and corresponds to a sorting of 2/3 the best. the real selection, 0.18 points of intensity of selection could be gain by using the real rate of selection (54% of the mares become brood mares) but that remains less than the realizable profit in the same way on the male side. It is on the other hand difficult to consider better demographic possibilities because that correspond to a choice among 13 covering carried out if a test on performance is wanted, which is already a good longevity of broodmare. Without performances, the sorting is done on 7 coverings thus 7 years of reproductive career. The mothers of stallions, are actually selected (i=1.90). A progress is possible because if the stallions are only 1.7% of the births, one can reasonably plan to choose them among 3.4% of the best brood mares (i=2.22).

The interval of generation in the males is too long: It reaches in 2002, 13.5 years after having stagnated a long time about the 12 years. It is not justified by the progeny test, because this one must remain marginal. It is not explained by the late setting to the reproduction of the stallions, since those have their first products on average at 6.9 years, but by a too long utilisation period, that was deduced equal to 14.2 years. Time necessary to test the first generation in competition does not exceed 6 years, 7 years for two generations. The breeders should not use 7 years more the stallions. In fact, this is the mark of a bad test on progeny, the young stallions do no produce enough offspring, to reach a sufficient precision on progeny selection still requires too much time; It is urgent to rebalance the covering to the young stallions and that without lowering the age of setting to the reproduction, which is not responsible for the long interval of generation and which is necessary for the performance selection. The 2 years could variation between the interval on the way sire/sire and sire/progeny continue to be justified by the use of males tested on progeny like sire of stallions

It is surprising to note an age of setting to the reproduction much later in the mares compared to the males: 7.8 years against 6.9 years, while at the same time the test on performance is not generalized. A mare cannot carry out a sporting and reproductive career, it should stop the first to start the other but the returns to the breeding spread out much too late in their life. To incite these mares to leave the show jumping for example after their performance at 5 years old , which constitute already a good criteria of selection would be an interesting measurement because it would not decrease the precision hoped but shortening the interval of generation. By removing the mares which covered for the first time after 10 years, we decrease the interval of generation by 1.2 years. It is not possible step to decrease the utilisation period (8.8 years) without touching the intensity of selection.

5.2 Contributions of the other races

Expect of the recent phenomenon of the foreign sport horse, the influence of the other races decrease and now it is only symbolic: 7% of the crossing. It is rather an assessment of the past which we can draw up today. This influence was negative for the selection for the show jumping. The intensity of selection on the way sire/offspring is 0.31, that is to say a quasi non-existent selection. It is even unfavourable for the way dam/progeny (intensity equal to -0.59). On the level of the generation interval, it increase a lot when it is about sire-non-SF or dam non-SF/sire-SF and it makes lose 1 year for the way sire-no-SF/dam-SF. It is a negative assessment from any point of view.

Now, the problem arises in a different way for the foreign sport horse; on the file from study, the retreat was not enough strong so that we cannot calculate the parameters of genetic progress. It will be in all ways often difficult to know the genetic level of the selected reproducers because their performances and those of their family were often carried out abroad, and the respective level of the various races is unknown. It is a study of the first productions left competition which start to be significant in 2004 that it is necessary to carry out.

5.3 Inbreeding

Average inbreeding in 2002 is 1.4%. It is far from the critical zone which is beyond 5%. Inbreeding seems non required because when we look at individual inbreeding rate of the horses less than 2% of the births have a rate higher than 1/16ème (6.25%). Inbreeding is actually related to rather remote genealogical bottlenecks in the pedigrees which appear clearly with the study of the major ancestor and with the inbreeding rates with a limited number of generations.

It will be noticed that the increase was reduced while at the same time one authorized a greater number of covering per stallion.

6 CONCLUSION

The current system seems fairly effective if we look at the sorting of the stallion during approval. But it is actually rather powerful by the modulation that bring the breeders in their choice of the covering (the stallion work unequally) and they really sort tri the mares. The progress made on the principal objective: the success in show jumping, approximately 9% of annual genetic standard deviation is significant. The recent contribution of progeny selection was a great benefit (+10% of genetic progress). The improvements suggested can play only margin but are simple to realize: really use (by taking the best) the rates of selection used in the females (+5% of genetic progress) in the males (+10%), support the return to the breeding of the females of 4 and 5 years with performance (+5%), use normally the young males with performance (+10%). All these proposals allows a total profit of 30%. By keeping this structure of population, finally effective for a selection on the show jumping, the true debate of tomorrow is to add to it other characters of interest (conformation, gate, health, behaviour, reproduction) while preserving progress carried out. That can be done only by preserving the structure of effective test on performance. Moreover, it should be noted that although the genetic variability of the SF really does not seem in danger, it is necessary to remain vigilant and preserve it in order to be able to continue to select.

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