Can We Control Inbreeding?

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The Friesian horse and inbreeding seem to be connected at the hip. This is mostly because of our choice for a closed studbook. By making this choice, and because of the changing popularity of the Friesian horse in the previous 125 years, the breed has been through a "genetic bottle neck" several times. The question is: how large is the problem of inbreeding in 2003? How does it manifest itself? How can we make it manageable in our breeding programs?

Inbreeding has been defined as the extent to which both parent animals of an individual animal are genetically related. This relationship is expressed in the inbreeding-coefficient. Inbreeding is sometimes regarded as a means to strive for uniformity in the breeding. If this produces good products, we call it family-breeding or linebreeding; if the result is disappointing, we call it inbreeding. In general we can say that inbreeding causes loss of genetic variation in the population. It is remarkable that the consequences of inbreeding are similar in all animal species. The result of inbreeding: hereditary defects will occur more often in larger numbers. Just slightly less visible is the negative effect of inbreeding on the so-called fitness characteristics such as fertility, illness-resistance and life span. Characteristics that may not get as much attention as exterior and utilization, but nevertheless, must have a prominent place in the breeding goal, and also in the breeding goal of the Friesian horse.

ECONOMICAL GROWTH AND INFLATION

In addition to the negative effects on the fitness characteristics, inbreeding and loss of genetic variation will also lead to a decrease in genetic progress in the long run. After all, if there is no variation left, there is nothing left to select. Genetic progress and inbreeding relate to each other as economical growth to inflation. In case of a strong economical growth, the inflation generally increases, among other things, because of the increasing wages. At a certain point in time the inflation is so high that the economical growth decreases, and things will take their course. For instance, if we only use the 2 best stallions, this will have the short-time effect (one generation) of an optimum genetic progress. But the result of this action, inbreeding, will make sure that the next generations will have no genetic progress whatsoever. For that reason, a breeding policy will have to find a balance between a well-defined selection on one side, and sufficient blood spreading on the other side.

LOWER INBREEDING COEFFICIENT

To get an idea of the degree of inbreeding, we need to depict the course of the average inbreeding coefficient over a large number of years in a diagram. However, the discussion is how many generations do we have to include in the inbreeding calculation: 5 generations, 10 generations or all generations that go back to the origin of the breed? In science the last calculation is often used, but this way of calculation doesn't give us a closed and shut answer. After all, the foundation stock of the Studbook, with their lineage unbeknownst to us, are considered to be unrelated. The choice of the FPS to take 5 generations as the basis to calculate the inbreeding calculation is a practical choice.

The narrowing of the bloodlines, due to temporary problems with regards to the population size from previous times cannot be mended with breeding activities anymore. In the breeding we generally don't look at the absolute inbreeding level, but rather at the increase in inbreeding coefficient per foals per year.

Diagram 1 depicts the inbreeding coefficient (in 5 generations) per foals per year over the last 30 years. The diagram shows a downward trend. This is a positive development, thanks to the increase of the population, the inbreeding advice and the use of blood spreading in the stallion selection. When we look at the inbreeding from the origin of the Friesian horse, we find a light increase of the inbreeding coefficient; a decrease is theoretically impossible. After all, no (foundation) animals are added.

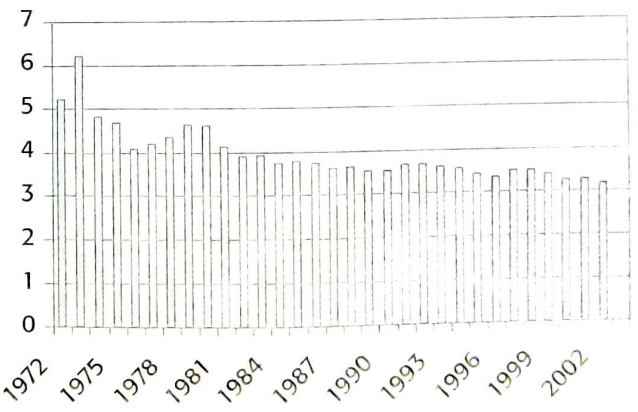

Diagram 1. Average inbreeding coefficient per foals per year over the past 30 years.

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CAN WE CONTROL INBREEDING? cont.

A SOME WHAT FLAWED RELATION

The relation between the degree of inbreeding and the prevention of problems regarding fitness characteristics has barely been researched within the Friesian horse population. This is, however, highly advisable because the Friesian horse has problems related to these characteristics (for instance fertility), in particular in relation to other horse breeds. Even as we speak, Drs. A. Sevenga, veterinarian, researches the relation between inbreeding and retaining the afterbirth in the Friesian horse. He made the unequivocal observation that the inbreeding coefficient of the foal has a positive connection with the retaining of the afterbirth of the mother - see Phryso, February 2002.*

A similar research must be done about, for instance, the fertility characteristics, such as sperm quality of stallions. It is also interesting to research the number of generations in the inbreeding calculation that are relevant in this context. For the singular recessive characteristics it is especially important to localize the relevant gene in the DNA, so a test can be developed. For the "red factor" this has already been accomplished, but not yet for the "midget factor." We must come to the conclusion that more research in the relation between inbreeding and the prevention of hereditary defects in the Friesian horse is necessary.

BLOOD SPREADING

As we mentioned before, blood spreading must play an important role in the selection of parent animals for the next generation. Two factors are important in this matter. First we have to prevent that a certain animal (stallion) will have an overly large influence on the breeding. Secondly, we must study in what degree a certain animal can deliver new blood into a population. In other words: what is the relationship of a certain animal (stallion) with the population. The Phryso has published several articles that reflect on the relation of the inbreeding problem with the observation that the Friesian stallions descend more and more from only one stallion line, the Tetman line. However, this gives a limited picture of reality, because the male line forms only a part of the total lineage of a horse. To depict what the contribution of a stallion is as supplier of new blood, we could study what the average inbreeding coefficient of the descendants of that stallion is. Chart 1a and 1b give an overview of the stallions (with at least 100 descendants) with the highest and lowest average inbreeding coefficient of the descendants. The charts give an insight in which stallions contribute to blood spreading and which stallions cause blood narrowing. It is remarkable that a number of representatives of the Tetman line take care of blood spreading (such as Tsjerk, with a mother line that is grafted on Age), and that other stallions from a non-Tetman line cause blood narrowing. (Fede: Jelmer - Ritske line x Hearke x Wessel). Especially the stallions with Wessel in their pedigree show a predominantly higher inbreeding percentage in their offspring.

CHART 1A
Low Inbreeding Coefficient

Stallion	Average inbreeding % of the offspring
Fabe	1.86
Frans	1.97
Sape	2.04
Nykle	2.36
Olrik	2.36
Wander	2.50
Jorrit	2.54
Maiko	2.56
Anton	2.65
Tsjerk	2.70

The 10 stallions with the lowest average inbreeding coefficient in their offspring

CHART 1B
High Inbreeding Coefficient

Stallion	Average inbreeding % of the offspring
Warn	4.99
Sierk	4.61
Folkert	4.50
Fede	4.27
Dirk	4.24
Rypke	4.23
Otte	4.22
Piter	4.09
Fetse	4.09
Lute	4.09

The 10 stallions with the highest average inbreeding coefficient in their offspring

***Ed note - In her guest article in The Friesian, April/May 2003, Dr. Karen Salvage, PhD, refutes that this particular study supports the hypothesis that inbreeding influences retained placentas on the data provided, since no tests of statistical significance were published in the Phryso.}**

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CONTROL INBREEDING? cont.

HOW TO CONTROL INBREEDING

The important question is: how can we control inbreeding? This question would actually be answered on 3 levels:

1. mare keeper level
2. stallion selection level
3. breeding program level

At the mare keeper level it is important that the inbreeding coefficient won't be too high in the combinations. The FPS advises to pair animals that have a maximum inbreeding coefficient of 5% in 5 generations. The FPS can provide an inbreeding list for every mare; it gives the inbreeding percentage in combination with all available studbook stallions. At this point in time we can say that for every mare there is a sufficient supply of stallions that meet the required inbreeding criteria.

For the appointments and selections of our studbook stallions, we must make a decision on the basis of the (expected) breeding value and contribution to the blood spreading. The intensity of the use of a stallion in the population (for instance, as father of young stallions) will have to depend on these two criteria. At the breeding program level we encounter a more complicated matter. In principle, the breeding program is a collection of selection steps (star predicate, stallion show, Central Examination, offspring examinations, ABFP test, etc.). Just like the Central Planning Bureau can calculate the economical growth and inflation from the effect of economical policy, the applied breeding program can be calculated in terms of genetic development (from the breeding goal characteristics) and inbreeding. This way alternatives and adjustments regarding the breeding program can be calculated and a long term effect can be estimated. Especially this last subject will have the full attention of the FPS in the coming months. Because using a sound, long term breeding program is one of the most important tasks of the Studbook. And it is obvious that inbreeding is a very important part of the breeding program.

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