New Help for Inbreeding Coefficient

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Last year the KFPS, along with the University in Wageningen, began a study into the breeding problems of Friesian horses. In this study, they are looking for answers that affect the breeding program, such as, "what is the best way for the KFPS to optimize the breeding program, making inbreeding more problem free?" They will be looking at stallion breeding restrictions, the ideal number of active stallions, etc. Another relevant question is how those horses within the general Friesian population can be identified that add a greater distribution of the blood lines. The answer to the latter is the relationship percentage.

An important factor in a restricted breeding registry is the inbreeding. This certainly is a factor for the KFPS, since the population went through a "bottleneck' several times in its history. These 'bottlenecks' are those times when the Friesian population was in strong decline. In the 1970's, when the Friesian horse was at a low point, we lost many genes.

The population is now bigger than ever but the gene pool has virtually remained the same. In other words, there is now more of the same. Data shows that the KFPS has an inbreeding coefficient of 1.7% per generation. An average norm for the maximum addition to each generation should be 1%. This normal has been exceeded - in fact, by too much. To stop the increase in inbreeding percentages, it is important to find those Friesian horses who have limited genes in respect to the rest of the population. These horses need a chance in the breeding program. It is not easy to find and choose these horses, because the inbreeding cannot be seen at first glance on the pedigree. A horse can have a free pedigree in 5 generations, but going further back, the family tree is no longer free but hopelessly tied up.

INBREEDING PERCENTAGE

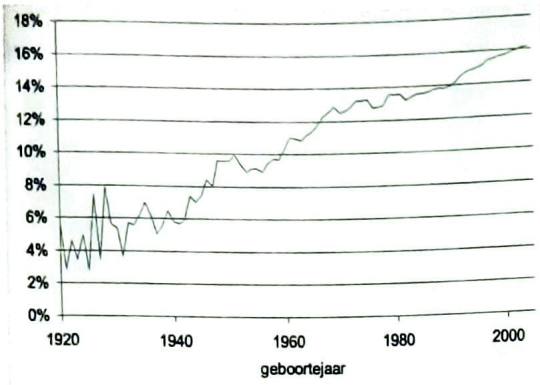
Several years ago, the KFPS introduced the inbreeding percentage to help stop the inbreeding ghost. On the registration paper for each horse, the inbreeding coefficient in the last 5 generations was printed. The KFPS advised avoiding inbreeding larger then 5%. This advise has been followed, since the inbreeding in the last 5 generations has slowly decreased and is now at an average of 3%. In contrast to this figure, is the actual inbreeding when all the generations are taken into consideration - it has increased to an alarming 1.7% per generation. The inbreeding percentage from all known generations is, at this time, at 16% (See figure). In comparison, a pairing of half brother with half sister is a minimum inbreeding of 12.5%. The inbreeding percentage within 5 generations is used as a factor to fight the inbreeding, and is used for stallion selection. By avoiding close inbreeding, it will help eliminate problems with genetic defects. There is a misunderstanding that the inbreeding percentage of a stallion will help contribute to his spreading of the blood lines. It is incorrect to state that the descendants of stallions with a low inbreeding percentage will have a lower inbreeding percentage than the descendants of a stallion with a high inbreeding percentage. The inbreeding percentage only states how related both parents of a horse are. As an example, a horse with an inbreeding percentage of 20% can get descendants with an inbreeding percentage of 0%.

RELATIONSHIP

The inbreeding percentage is a help in preventing inbreeding problems in the individual horse. Another strategy is needed to prevent inbreeding problems in the general population. Instead of looking at the inbreeding percentage of a horse, it would be more beneficial for the breeding program to see how related a horse is to the general population. In other words, will this horse bring in genes that will contribute to the inbreeding or decrease it? This is very important in the selection of approved stallions. The problems are in the fact that, with a stallion, not only should the first 5 generations be considered, but all the generations back. This is why the relationship percentage has been developed. The relationship percentage of a stallion is figured by the inbreeding of possible descendants with all the mares in the Friesian population. This population is defined as approximately 6,000 fillies born in 2003 and 2004. The relationship percentage of a stallion consists of an average actual (all known generations included) calculation of all 6,000 possible descendants. The defined mare population will move up one year, each year. In the situation where a stallion has many offspring, his relationship with the general population

will logically increase. This will be shown in the relationship percentage because over time more possible father - (grand) daughters will occur. The relationship percentage of a stallion is thus dependant in which way his blood lines are related to the rest of the Friesian population and how much he has been used.

Figure



Figuur 1. Inteeltverloop binnen de populatie van Friese paarden

RELATIVELY SMALL VARIATIONS

In the table on the next page are the relationship percentages of the present approved stallions. It appears that the lowest percentage in the stallions is about 15% and the highest is about 19% - maximum difference of only 4%. The conclusion is that we can no longer speak of "free blood." It can appear so in the first 5 generations of a stallion, but a further look into the pedigree shows the opposite is true. To allow these variations in relationship in stallion selection can still increase the relationship percentage in a decreasing inbreeding coefficient. The lowest percentages in the stallions is not the only criteria. The chance would be much larger to have more half brothers on the father's side selected, which would then lead to more inbreeding problems in the next generations to come. In addition to the low relationship percentage, the variations in the blood lines have to be looked at in approving stallions.

WHICH BLOODLINES?

The question is which stallion or which blood lines will help solve the inbreeding problems. The general view - to look for Ritske blood and avoid Tetman lines - is not correct. At this moment the male Ritske blood line is thin, but Ritske plays a more dominant role in our population then Tetman and Age. You can see this is the relationship percentage of Tetman (16%), Age (16.9%) and Ritske (19.5%). This is the logical result of the dominant position of Ritske in the mother lines. Even the older generation stallions, Danilo and Obscurant, born in 1924 and 1934 respectively, are on a norm with the present stallions at around 16%. When we look at the younger generation, "impact stallions," like Jochem (20.2%), Reitse (19.3%) and Wessel (18.8%), seem to have a negative impact and stallions like Naen (14.1%) and Lammert (15.9%) have a positive impact.

Actually, "line thinking" does little in the fight towards in-breeding. This is logical, considering that many stallions from the Tetman line bring in more Ritske blood than the stallions from the Ritske line. Many Tetman stallions have Ritske blood in their veins. On an average, our present stallions bring in about 20% blood from Ritske; Tetman and Age have an average of about 10%. When we look at the stallions with a low relationship percentage (lower than 16%) it appears that these are usually disqualified stallions. This of course is logical, because stallions with fewer offspring will have less influence in the breeding program. To push inbreeding back, and at the same time not suffer in quality, the stallions with a low relationship percentage (16% and lower) need a positive chance to influence the future generations. Stallions like Erik 351, Wander 352, Fabe 358, Ouke 313, Nykle 309, Jakob 302, Olrik 383 and Sape 381, and young stallions not yet approved on offspring, like Ielke 382, Doaitsen 420, Gjalt 426 and Beint 418, have the lowest relationship percentage.

MARES SHOULD BE INCLUDED

To stop the increase in inbreeding percentages, it makes sense to look beyond the stallions. Using the "relationship percentage," we could find those mares with an "outcross" bloodline and use them as stallion mothers (as long as quality is maintained). This method will have a drastic change in direction of the breeding program.

CONCLUSION

1. The relationship percentage gives the inbreeding as it relates to the general population. The lower the relationship percentage, the more the stallion will contribute to the spread in the blood lines and push back inbreeding.

2. The relationship percentage is dependant on how a stallion's blood line is in the norm with the general population, or how it deviates from the norm, and how intensively he has been used in the breeding program.

3. The percentage in relationship percentage with all the approved stallions is not very large. This means that you can barely speak about "free blood" anymore.

4. By giving those stallions (and mares) with a low relationship percentage a chance, we can push back the inbreeding problems.

Continued...

Inbreeding Coefficient, Cont.

Stallion	Relationship %	Bloodline (in %) Tetman	Age	Ritske
Feitse 293	19.6	12.5	23.4	12.5
Gerlof 294	17.0	12.5	18.8	18.8
Hannes 296	15.1	12.5	9.4	15.6
Ids 300	16.3	12.5	6.3	18.8
Jillis 301	18.1	12.5	15.6	25.0
Jakob 302	16.0	12.5	12.5	15.6
Lute 304	17.4	12.5	10.9	15.6
Ludse 305	16.5	6.3	10.9	25.0
Leffert 306	18.9	9.4	10.9	28.1
Lukas 324	17.2	21.9	18.0	15.6
Melle 311	16.6	12.5	13.3	18.8
Piter 312	17.2	12.5	12.5	25.0
Ouke 313	15.7	12.5	6.3	18.8
Olof 315	17.7	6.3	7.0	18.8
Sjaard 320	17.4	9.4	9.4	23.4
Rypke 321	18.4	12.5	16.4	15.6
Sierk 18.3	18.3	15.6	7.8	31.2
Remmelt 323	18.0	12.5	14.1	21.9
Ritse 322	17.5	6.3	17.2	21.9
Ulke 338	18.0	12.5	12.5	18.8
Thomas 327	18.0	15.6	18.0	28.1
Tsjerk 328	17.4	6.3	24.2	6.3
Wander 352	15.6	9.4	10.2	12.5
Warn 335	17.7	18.8	11.3	17.2
Anne 340	18.4	12.5	10.9	18.8
Abe 346	16.5	12.5	10.9	15.6
Abel 344	18.1	12.5	9.4	21.9
Brandus 345	18.5	9.4	13.3	18.8
Anton 343	17.1	9.4	18.0	10.9
Fêde 350	17.1	15.6	7.0	21.9
Folkert 353	19.5	15.6	14.8	21.9
Fetse 349	19.3	10.9	19.5	18.0
Feike 395	17.3	6.3	11.7	23.4
Fabe 348	15.6	6.3	12.9	21.9
Erik 351	15.6	9.4	9.0	18.8
Heinse 354	17.6	6.3	13.3	26.6
Ielke 382	15.6	7.8	9.0	16.4
Goffert 369	17.1	6.3	12.5	21.9
Gradus 356	18.8	12.5	10.2	20.3
Gerryt 360	18.0	9.4	12.9	25.0
Karel 370	17.0	9.4	10.6	17.2
Lolke 371	18.4	10.9	17.2	15.6
Jasper 366	16.7	9.4	8.2	18.8
Olrik 383	16.1	7.8	16.0	15.6
Nanning 374	17.8	8.6	17.4	17.6
Onne 376	17.8	14.1	9.4	20.3
Monte 378	17.0	13.3	14.3	22.3
Mintse 384	17.7	7.8	12.5	25.0
Sibald 380	18.1	11.7	10.2	26.9
Sytse 385	17.3	7.8	14.1	17.2

Stallion	Relationship %	Bloodline (in %) Tetman	Age	Ritske
Rindert 406	18.1	10.9	14.5	18.8
Rintse 386	18.0	10.9	12.1	18.0
Rik 396	17.7	12.5	14.1	17.2
Sape 381	16.3	6.3	12.3	16.4
Tsjitse 387	17.9	7.8	14.5	21.9
Tsjibbe 388	17.0	12.5	13.3	18.4
Teeuwis 389	18.6	10.2	16.2	21.5
Ulbert 390	18.0	10.2	6.6	35.2
Tonke 391	17.6	12.5	10.9	26.6
Teade 392	16.2	8.6	16.1	12.1
Tonis 393	18.4	10.9	15.6	21.1
Tsjalke 397	17.6	7.8	15.2	20.3
Time 398	17.0	5.5	9.8	16.8
Tsjipke 399	17.9	12.5	13.3	20.3
Tetse 394	17.4	9.4	8.6	19.5
Tjesse 400	16.9	10.9	7.8	21.1
Tije 401	16.2	6.3	10.4	26.6
Wibe 402	17.5	10.9	19.5	10.2
Wobke 403	17.9	8.6	16.4	18.4
Wikke 404	17.2	7.8	15.2	21.1
Ymte 407	18.3	11.7	14.1	19.1
Winand 405	16.1	7.8	11.1	21.1
Wisse 408	17.0	9.4	9.8	19.5
Wierd 409	18.2	10.9	15.6	17.2
Ait 410	19.1	13.3	18.2	14.8
Beart 411	16.8	7.8	10.0	14.1
Arjen 417	16.4	11.7	13.9	19.5
Bente 412	17.1	7.8	15.0	20.3
Brend 413	17.3	9.4	13.7	18.0
Botte 414	16.6	10.6	14.2	15.0
Beintse 418	15.9	9.4	11.5	16.4
Andries 415	16.9	7.4	16.9	12.9
Aan 416	16.4	10.9	7.4	18.8
Eibert 419	18.6	13.3	12.7	19.5
Doaitsen 420	15.8	9.4	7.0	15.6
Felle 422	17.7	11.7	16.6	17.2
Dries 421	17.1	14.1	10.7	16.4
Fridse 423	16.7	8.6	15.6	16.0
Harmen 424	17.1	10.2	14.3	16.8
Haitse 425	17.3	10.9	10.7	19.9
Gjalt 426	15.8	7.0	6.1	19.5
Hinne 427	16.9	7.8	18.0	13.3
Average	17.3	10.5	12.9	19.2