EFFECT OF INBREEDING ON PERFORMANCE TRAITS OF RIDING HORSES BASED ON COMPETITION RESULTS OF THE RACES "HOLSTEINER" AND "TRAKEHNER" WARMBLOOD

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SUMMARY

The effect of inbreeding on the genetic performance capacity of horses in sports was analyzed on the basis of Holsteiner and Trakehner warmblood horses in the FRG. For both races only a low degree of inbred horses was found resulting in an average inbreeding coefficient of F = 0.3 - 0.4%. The genetic performance capacity was estimated using BLUP-animal model for the trait "earnings per ranking" in show jumping and dressage. Although correlations between the inbreeding coefficients and the breeding values are very low, they nevertheless show a negative trend in the Trakehner breed and in the dressage performance of the Holsteiner breed. A positive correlation between inbreeding and the jumping ability in the Holsteiner breed may be explained by a strict selection for jumping on the basis of a few sires. Since inbreeding depressions on the genetic performance of riding horses are expected, the effect of inbreeding should be closely observed in future.

INTRODUCTION

Genetic progress in horse breeding is determined by a number of biological factors, among which inbreeding is one. If an increase of inbreeding concides negatively with the additive genetic performance ability, the decrease of breeding lines causes a depression in performance.
Since an increase in the number of progeny and therefore a reduced number of sires is necessary for an unbiased estimation of the genetic performance potential, a fear for increased inbreeding exists because of the necessary strict breeding programme.
The effect of inbreeding depressions on genetic performance was analyzed using data of the races "Holsteiner" and "Trakehner" warmblood.

MATERIAL AND METHODS

For the Holsteiner and Trakehner breed the WRIGHT inbreeding coefficients were calculated on the basis of all horses registered in the stud-books. The pedigrees could be completed up to the 4th generation whereby the degree of unknown ancestors was measured applying the completeness index (CI) described by Maccluer et al. (1984). The inbreeding coefficients were calculated using a programme developed by Maccluer (1967) on the basis of Kudo's method (1962). This means that every paternal line was compared with the maternal lines to find a common ancestor.
The breeding values of the breeding value estimation based on competition results of riding horses were available for stating perfor-

mance traits (Meinardus, 1988)[1]. The breeding value trait for the two disciplines "show jumping" and "dressage" was based on the natural logarithm of "earnings per ranking".
Combination of the various datasets lead to varying data records available per discipline and race. Since a computerized stud-book had been used for a longer time, 7946 (3495 resp.) records of the Holsteiner breed could be taken into account. The Trakehner breed was limited to only 1348 (1309 resp.) records (Table 1).
The average inbreeding coefficient is approximatively the same for both datasets (F = 0.3 - 0.4%) with a completeness index of CI = 65%. In all datasets the percentage of inbred horses amounts to 11 - 12%. These spot-test results correspond with an inbreeding analysis of Holsteiner material based on the complete stud-book (Wilkens, 1989).

RESULTS

Table 1: Correlations between inbreeding and breeding values with a varying degree of precision of breeding value estimation

	Holsteiner				Trakehner			
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
	all		$r_{BV} > 0.6$		all		$r_{BV} > 0.6$	
show jumping								
n	7946		4351		1348		287	
F	0.30	1.21	0.31	1.28	0.41	1.60	0.51	1.98
CI	67.4	24.9	70.4	22.4	64.9	27.2	67.7	21.4
BV	100	20	103.4	23.2	100	20	94.4	22.4
r_{BV}	0.50	0.20	0.65	0.04	0.37	0.22	0.70	0.09
r_{BV-F}	0.04		0.04		-0.05		0.02	
b_{BV-F}	0.74	0.20	0.80	0.31	-0.39	0.22	0.10	0.42
dressage								
n	3495		1020		1309		212	
F	0.26	1.10	0.29	1.33	0.43	1.44	0.46	2.00
CI	64.1	26.0	67.4	23.2	67.4	26.8	70.1	20.9
BV	100	20	106.4	26.6	100	20	97.2	22.4
r_{BV}	0.44	0.20	0.63	0.37	0.36	0.21	0.69	0.08
r_{BV-F}	0.01		-0.04		-0.03		-0.15	
b_{BV-F}	0.01	0.30	-0,70	0.61	-0.37	0.30	-1.26	0.59

n : number of horses
F : coefficient of inbreeding (%)
CI : completeness index (%)
BV : breeding value
r_{BV} : precision of breeding value estimation
r_{BV-F} : Pearson correlation between breeding value and inbreeding
b_{BV-F} : regression coefficient of breeding value on inbreeding

[1] The data of the breeding value estimation were kindly provided by the computer centre Verden (RLN)

The correlations between the inbreeding coefficients and the breeding values are described by Pearson correlation coefficients. Taking all horses into consideration table 1 shows that in neither of the two races such a correlation was found for the discipline "show jumping". In the dressage performance of the Trakehner a negative correlation of about $r_{BV-F} = -0.15$ was indicated provided the precision of the breeding values reached a minimum of $r_{BV} = 0.6$. A more exact estimation of genetic value does not lead to a change in the correlation between inbreeding and breeding value in the show jumping and dressage performance of the Holsteiner breed.
If only the inbred animals ($F > 0$) are taken into consideration an increase in the correlations can be stated, which in the case of the Trakehner is due to a limited number of horses. There is however a tendency towards an increase of the negative trend. Contrary to that there is a slightly positive trend between inbreeding and breeding values in the Holsteiner breed.

Table 2: Correlations between inbreeding and breeding values of inbred horses with varying degree of precision of breeding value estimation

	Holsteiner				Trakehner			
	$\bar{x}$	s	$\bar{x}$ $r_{BV} > 0.6$	s	$\bar{x}$	s	$\bar{x}$ $r_{BV} > 0.6$	s
show jumping								
n	962		518		178		46	
F	2.48	2.60	2.63	2.76	3.13	3.29	3.19	4.03
CI	86.9	7.9	87.4	7.8	88.0	10.7	88.3	11.1
BV	101.0	17.8	104.1	18.4	97.0	18.3	98.4	23.6
r_{BV}	0.51	0.20	0.64	0.03	0.41	0.21	0.66	0.07
r_{BV-F}	0.13		0.16		-0.04		-0.10	
b_{BV-F}	0.91	0.23	1.17	0.32	-0.15	0.26	-0.35	0.55
dressage								
n	377		112		200		30	
F	2.43	2.46	2.6	3.2	2.81	2.64	3.23	4.47
CI	86.3	8.1	87.7	8.2	89.8	9.7	84.5	12.0
BV	97.8	16.2	103.9	21.8	98.1	19.4	94.3	21.6
r_{BV}	0.49	0.20	0.63	0.37	0.39	0.20	0.67	0.06
r_{BV-F}	0.04		-0.07		-0.02		-0.39	
b_{BV-F}	0.23	0.33	-0.49	0.63	-0.12	0.40	-1.47	0.65

DISCUSSION

The correlations between inbreeding and breeding values are very low for both races. On the one hand this is due to the low degree of inbreeding and on the other hand it is due to the limitation of data. The estimated regression coefficients (b_{BV-F}) show that inbreeding only lead to small changes in the breeding values. Nevertheless tendentiously differentiated results are detectable. The positive correlations in the discipline

"show jumping" in the case of the Holsteiner are remarkable. The more precisely the breeding values are estimated the more this becomes clear. This shows that a strict selection on the basis of jumping ability is the reason for the positive correlation contrary to the expected value. In breeding this lead to a restriction of a few sires with an extraordinary jumping talent.

For the Trakehner breed in general as well as for the Holsteiner breed in dressage a tendency towards an inbreeding depression can be stated. The selection of Trakehner did not concentrate primarily on the performance of the sires in sport but it was aimed at conformation. Therefore the inbreeding effects on competition results are not concealed.

According to the results it seems to be necessary to further investigate the effect of inbreeding, which may become more important with an increased application of artificial insemination. Therefore modern methods of breeding value estimation are helpful to establish the genetic value. A permanent control of breeding supported by a strict breeding programme makes a control of inbreeding possible. As the Holsteiner breed shows inbreeding depressions may be covered up by a superiority in performance.

REFERENCES

KUDO, A. 1962. Am. J. Human. Genet. 14: 426-432

MACCLUER, J.W., GRIFFITH, R., SING, C.F. and SCHULL, W.J. 1967 Am. J. Human. Genet. 19: 189-231

MACCLUER, J.W., BOYCE, A.J., DYKE, B., WEITKAMP, L.R. and PFENNIG, D.W. 1984. J. of Heredity 74: 394-399

MEINARDUS, H. 1988. Thesis Göttingen

WILKENS, J. 1989. Thesis Kiel