BREEDING VALUES AND ESTIMATION OF GENETIC TRENDS IN GERMAN THOROUGHBRED HORSES

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SUMMARY

Compared with other populations the thoroughbred population in the Federal Republic of Germany is very small and it is characterized by a high number of owners in relation to horses. If important systematic environmental effects (e.g.trainer) are not taken into account in genetic evaluation, breeding values are biased and heritability as well as genetic progress is over-estimated. In spite of strict selection of stallions on the basis of their own racing performance only little genetic progress in thoroughbred population of the FRG was obtained.

INTRODUCTION

The annual genetic gain in a breeding population depends essentially on its extent and structure, performance testing and breeding value estimation as well as on its breeding programme. From the breeder's point of view selection works far better for thoroughbred horses than for warmblood horses because it is done on the basis of performance testing in racing competitions.
If selection is exclusively carried out for one economically important trait with average heritability a measurable genetic gain should be expected after some years.
On the basis of thoroughbred horses in the Federal Republic of Germany this paper is to show the genetic variance for different traits and the genetic trends that has been achieved.

POPULATION STRUCTURE AND PERFORMANCE TESTING

The number of 2 200 registered mares 1989 in the Federal Republic of Germany is very small in comparison with other thoroughbred populations. Due to the intensive international exchange of breeding animals thoroughbreds in the Federal Republic of Germany are not an independent population but merely a subpopulation of the worldwide thoroughbred horses.
A disadvantage for the effectiveness of the breeding programme is the high number of 1 000 breeders in relation to the number of brood mares because more than 80 % of the breeders only have one or two mares.
Selection of stallions is carried out on the basis of a minimum end-of-year general handicap weight of 95 kg which is identical with a rating of 110 in the international classification and more than 2.5 standard deviations above the average. The general handicap is allocated annually to characterize the shown racing performance. Its amount is a parameter for the weight which should theoretically be carried by a horse to guarantee equal winning chances for all classified horses in a 1 600 metre race in April the following year.
The ratio of owners of trained horses to breeders is 1.5:1 (about 1 600 owners). Every year about 2 200 races take place in the FRG with 22 000 starters of 3100 to 3200 horses of which only 10 to 12% belong to the group of 2-year-old horses.

Because of the low number of starts as 2-year-old horses and the intensive preselection implemented by trainer and owner racing performance as 3-year-old horses is decisive for the estimation of the genetic merit of a thoroughbred. Compared with ranking or earning per start the disadvantage of annual earning is that the main systematic effects like trainer, jockey, rivals and standard of race cannot completely be taken into account in breeding value estimation. If the effect of the trainer as an important sytematic environmental effect is to be taken into account in a genetic analysis of annual earning (Schulze-Schleppinghoff et al., 1987; Preisinger et al., 1989), all horses with a change of trainer during the racing-year must be excluded from analysis.

METHODS

A comprehensive linear model for variance components and breeding value estimation for racing traits of 3-year-old thoroughbred horses should include the important systematic environmental effects of sex, trainer, jockey, and race to exclude bias. Calculation of genetic trends can be done based on differences among horses belonging to different age-groups.
On the basis of all starts of 3-year-old horses recorded between year 1984 and 1988 (3750 horses of 108 sires with an average of 7 starts) the effect of a model restriction to estimated values on genetic variance and the calculated genetic trend are to be shown, using REML (Preisinger, 1987) for estimation of variance components.

RESULTS

Provided annual earning is chosen as criterion for genetic evaluation and the effect of trainer is not taken into account in estimation of variance components the estimated heritability is 51%. The corresponding estimated value for logarithmic earning per start or ranking is 13% or 14% respectively (table 1). If the environmental effects of race, jockey and trainer are incorporated in the model heritability decreases to 5% or 7% (complete model).

Table 1: Heritability for annual earning, earning per start and ranking when using different reduced linear models

	annual earning h^2	earning per start h^2	ranking h^2
complete model*)	0.11	0.07	0.07
race excluded	-	0.05	0.06
jockey excluded	-	0.06	0.07
trainer excluded	0.51	0.13	0.14

*) complete model with the effect of race, jockey, trainer and sex; for annual earning only with trainer;

While the items "jockey" and "particular rivals" in a race only have a negligible effect on the ranking of stallions, only the effect of "trainer" leads to considerable changes in raking if it is ignored (table 2).

Table 2: Spearman correlation coefficients for breeding values of sires using different reduced linear models

	complete model earning per start	ranking
race excluded	0.93	0.90
jockey excluded	0.92	0.91
trainer excluded	0.72	0.75

Figure 1: Genetic trend in ranking using different linear models

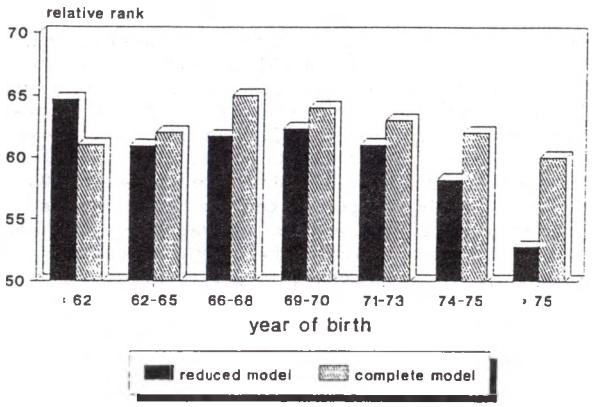
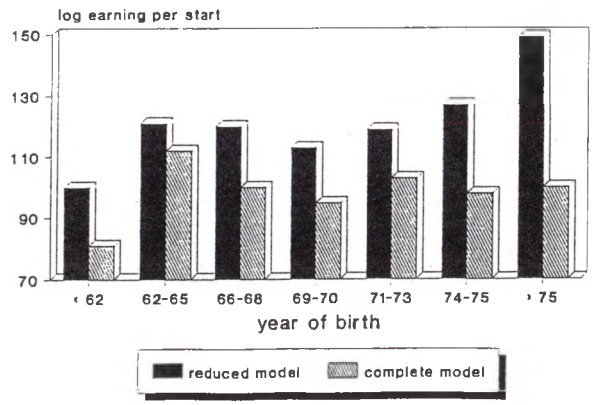


Figure 2: Genetic trend in earning per start using different linear models



In consequence of a reduced additive genetic variance as well as of essential shifts in ranking between sires the complete model leads to lower genetic trends for earning per start and ranking than to a reduced model (figure 1 and figure 2).

DISCUSSION

If the effect of "trainer" in the breeding value estimation for thoroughbreds is not taken into consideration, additive genetic variance is overestimated. This is especially true for annual earning.
In spite of strict selection of stallions on the basis of their own racing performance (obligation of licensing with a limit of 95kg in end-of-year general handicap) no essential genetic gain was obtained. If the effect of the trainer is not taken into account a significant genetic trend based on the age-group of the sires may be stated, as this analysis shows.
GAFFNEY and CUNNINGHAM (1988) also found a positive genetic trend in timeform of Irish thoroughbred horses. But since the effect of trainer was ignored the genetic trend may have been overestimated as this study seems to indicate. For the Spanish thoroughbred population CHICO et al. (1989) could not establish a significant genetic progress in racing performance. For the logarithm of earning a significantly but negative genetic trend was estimated. In the linear model they incorporated the effects of race, jockey and a permanent evironmental effect, which also included the effect of trainer. They concluded that lack of genetic progress is a consequence of ineffective breeding.
Based on present study and various results reported in scientific literature it can be said that additive genetic variance and genetic progress may be overestimated for thoroughbreds, if important environmental effects (e.g. trainer) are not taken into account.

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