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Genetic aspects of racing performance in Polish pure bred Arab horses. II. Genetic trends

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Abstract. The objective of this study was to estimate genetic trends in the Polish Arab horses population. Annual earnings and rank at finish in flat races of Polish Arab horses from 1951 to 1993 were analysed with a BLUP animal model. The collected data included 2,234 records of 1,640 4- and 5-year old horses from 143 sires. Only races, in which horses of at least two mentioned age groups took part, were taken into consideration. The model included an individual additive genetic effect as random, the year of race, herd, sex, age, number of starts and the year of race × age effects as fixed effects. Genetic trends were estimated from differences between horses belonging to different age groups and racing in the same year. The annual genetic gains from 1951 to 1993 were 3.5% and 12.3% of the genetic standard deviation for the log of earnings and rank at finish, respectively. Although the main role in breeding Arab horses is played by beauty and exterior, small genetic progress in the log of earnings and rank at finish was obtained.

Key words: Arab horses, genetic trend, racing performance.

Introduction

Races of pure-bred Arab horses have been maintained in Poland since 1927 almost without breaks. They are a real test of endurance for the breed of horses which were once distinguished by good health and condition. Data collected at race courses provide information necessary for selection as racing performance should be an important criterion in the evaluation and selection of animals used for breeding. The racing performance of a horse is a composite trait, consisting of speed, temperament, condition and adaptation to specific condi-

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tions of each race. Racing performance is difficult to define and methods of its evaluation are not sufficiently objective. OJALA and van VLECK (1981) separated as many as 24 traits determining racing performance and only 15 of them were connected with the horse's rank at finish. In the present work, racing performance is expressed as total earnings, evaluating the quality of a horse in relation to other animals and considered by many experts as the best indicator of racing performance (OJALA 1987, MEINARDUS 1988, TAVERNIER 1988, BRUNS 1990). Assuming that racing performance is a moderately heritable trait (LANGLOIS 1980, TOLLEY et al. 1985, OJALA 1987, KLEMETSDAL 1990, SOBCZYŃSKA, KOWNACKI 1997) and that the results obtained on the race course are reflected in selection decisions, there should be a positive genetic trend for traits measuring this performance. The present work was carried out to estimate genetic trends for racing performance traits in the Polish Arab horse population.

Material and methods

The racing performance of Arab horses was expressed by total annual earnings and rank at finish, to establish the place taken by a given horse at the race. The material and definition of traits and results of preliminary analysis were described by SOBCZYŃSKA and KOWNACKI (1997).

Due to the non-random mating structure and the existence of environmental factors, which also are not randomly distributed, the genetic analysis of Arab horses presents numerous problems. As the sire model overestimates additive genetic variance (KIEFFER 1975, TAVERNIER 1988), a BLUP animal model (JENSEN, MADSEN 1992) was used, which automatically corrects the non-random mating of animals. The following mixed model was applied:

$$\mathbf{y} = \mathbf{Xb} + \mathbf{Zu} + \mathbf{e},$$

where: $\mathbf{y}$ – vector of observation for the log of annual earnings or rank at finish, $\mathbf{b}$ – vector of unknown fixed effects of the year of racing, age, sex, no. of starts, herd and year × age interaction, $\mathbf{u}$ – vector of unknown random horse effects representing both genetic and permanent environmental effects, $\mathbf{e}$ – vector of unknown random residual effects, $\mathbf{X}$ – known incidence matrix for fixed effects, $\mathbf{Z}$ – known incidence matrix for random effects.

Since the repeatability estimates were of the same magnitude as heritability, estimates (see SOBCZYŃSKA, KOWNACKI 1997) the vector of random horse effect included virtually only the additive genetic effect. Genetic trends were estimated as differences between horses belonging to different age groups within the year of racing.

Variance components were estimated by the DFREML algorithm. The estimated heritability was 0.22 and 0.25 for the log of earnings and rank at finish, respectively. Genetic and phenotypic correlations among traits were 0.94 and 0.77, respectively (SOBCZYŃSKA, KOWNACKI 1997).

Results and discussion

A small positive genetic trend for total earnings (Fig. 1), reached 3.5% of genetic standard deviation. The genetic trend for rank at finish (Fig. 2) amounted to 12.3% of genetic standard deviation. On the assumption that the distance between generations is 10 years, the genetic progress amounts to 35% and 120% of genetic standard deviation for earnings and rank at finish, respectively. Comparing genetic trends for both traits one may observe that younger horses reach a higher rank at finish in less prestigious races, in which the awards are lower.

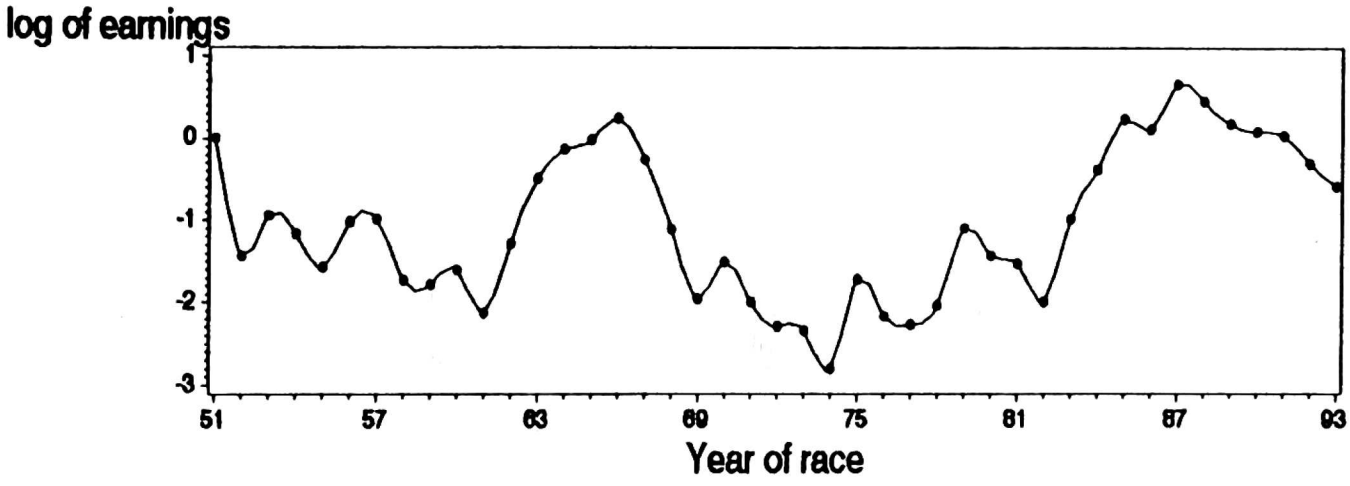

Fig. 1. Genetic trend in earnings in Arab horses population

A reasonable explanation of this may be the fact that better horses take part in the races with high endowment, which makes competition more difficult.

Since the early 1960's a gradual improvement has been observed in horse racing performance, which remained on a comparatively constant level over 10 consecutive years with regard to rank at finish, but it clearly decreased with reference to total earnings. These results reflect the situation in the Arab horse breeding. During the sixties an interest in Polish Arab horses increased, which resulted in an increased and systematic export of Arab horses to western countries, chiefly to the U.S.A. As a result of adjustment of the breeding work

to export demands, more attention has been paid to the animal's beauty than to its racing performance. In races of lower prestige younger horses won less money. At the end of the eighties this trend again began to decrease, principally with regard to total earnings.

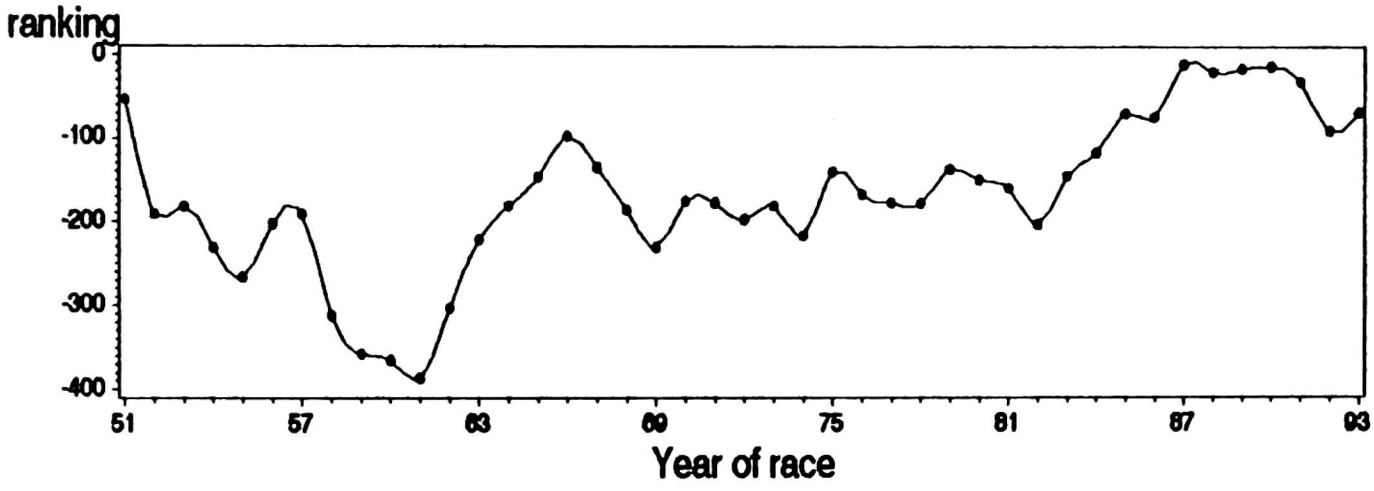

Fig. 2. Genetics trend in rank at finish in Arab horses population

Investigations conducted on thoroughbred horses (CHICO et al. 1989, PREISINGER et al. 1990) indicated that the omission of the effect of trainer or jockey from calculations leads to an overestimation of the additive genetic variance and genetic progress, especially in the case when racing performance is measured by annual earnings. Moreover, when summing up earnings, certain important effects, common in a given race, such as the condition of the track, distance or the number of running horses, are impossible to account for. This last factor seems to be of special importance, as races in which only several horses participate must be treated differently than those in which more horses take part. It is known that in higher paid races usually more horses participate and thus the competition is more difficult.

It should be remembered that the data collected in the present investigations referred only to those races in which horses of various ages took part. The applied method of estimation of genetic trends resulted from the character of racing performance traits or rather the way in which they are expressed. Neither the number of the first places nor the volume of earnings won by a horse can increase with the improvement of a horse's racing performance. The award pool is limited and only the share of individual animals in the pool may indicate their performance. After the end of the season many of the four-year-old horses are removed from the race course for numerous reasons. Thus,

if the number of poor horses remaining on the race course for another season constantly increased, the trend estimate biased upward. On the other hand, the group of younger horses includes animals not yet subjected to selection, and thus it may consist of a greater number of horses of a poorer racing performance. Investigations conducted on selected animals cause numerous problems. However, as shown by van der WERF and de BOER (1990), the animal model can account for the effects of selection and mating provided that a full relationships matrix is used and all the data on which selection is based are included in the analysis. The inclusion of additional relations between animals partly explains covariance, inbreeding and gametic disequilibrium, which cause deviations in the estimations of additive genetic variance. If the offspring is obtained only from selected animals, the relationship matrix describes which animals are parents of the next generations, which makes it possible to avoid potential deviations caused by selection. It is more difficult to avoid assortive matings of mares and stallions, which may change covariance values.

Conclusions

Despite the fact, that the principal criterion in the selection of Arab horses is their exterior, a positive genetic trend was observed for racing performance, expressed in total earnings and rank at finish. In view of the character of traits and the imperfection of measurements, the obtained results must be treated with caution.

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