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Original Paper

Influence of genetic parameters to the performance indicators in the championship for young horses

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Slovak Warmblood championship is a competition for young horses of given population, which is organized annually by the recognized breeder organization under the same test conditions. The aim of our study was to analyze genetic parameters and determine their potential impact on the performance indicators in championship for young horses of Slovak Warmblood population. Basic data consisted of the results of 761 horses that have qualified for the finals. From the analysis of genetic parameters on performance indicators we found that all factors: breeder, breed, line, gender, age of horse and year of the competition influenced the final ranking respectively the logarithm of ranking. But on the level of significance was only the factor breeder. The genetic assessment of monitored horses in tested competitions shows that factors breed and line high statistically influence Log R in particular competition. On the border of statistical support were fixed effects - degree of difficulty in the competition and year of competition. Based on our knowledge, we can conclude that in addition to the above factors on the ranking in competitions of sport form of testing has a major impact factor - rider.

Keywords: Slovak Warmblood, genetic parameters, performance of horses

1 Introduction

Performance monitoring is one of the most important parts of the breeding program in horse breeding. For achieving high quality results in the breeding it should therefore be carried out at the appropriate level, together with corresponding evaluation and processing of results. Performance of sport horse is conditioned not only by quality of the gene pool, but also by large number of external factors. Of these dominated mainly nutrition, quality of breeding, zootechnical care level, and not least the quality of rider and trainer (Braam et al., 2009).

Because of the long generation interval and low population of horses, any breeder can not rely on the method of examination of breeding horses in his breeding. To determine the expected performance help us now various statistical methods for estimating the breeding values that clearly highlighted a path that will be achieved the breeding success (Bartolomé et al., 2011).

Górecka-Bruzda and Jezierski (2010) observed that by all genetic indicators should take into account also degree of heritability and genetic correlations of individual characteristics of testing horses. Degree of heritability expresses whit what a genetic force will be a particular characteristic passed on to the next generation. Heritability below 20 % is considered to be insignificant, 20–40 % is considered to be the average and above 40 % is degree of heritability strong. Stronger heritability gives us higher premise to faster progress in our breeding program. This information is available much earlier and thus we can significantly shorten the generation interval. For example the degree of heritability of individual exterior characters of horses is: type and sexual type 23 %, head 41 %, neck 28 %, back 38 %, forelegs 16 %, hindquarters 18 %, robustness 36 %. A higher degree of heritability we recorded in performance, for example walk 26 %, trot 37 %, canter 30 %, rideability 29 % and jump in freedom 40 %. Correlations between the characters show us whether the individual characters are interdependent. The aim of our study was to analyze genetic parameters and determine their potential

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impact on the performance indicators in championship for young horses of Slovak Warmblood population.

2 Material and methods

Slovak Warmblood championship is a competition for young horses of given population, which is organized annually by the recognized breeder organization under the same test conditions.

Basic materials for processing this work were the results of competitions for young horses (4, 5, 6-year-old horses) for a period of five years.

Basic data consisted of the results of 761 horses that have qualified for the finals, respectively have competed in final competition for young horses.

In this work we evaluated:

- population size that participated in competitions for young horses,
- % of mares, stallions and geldings in the final competition of young horses,
- statistical evaluation of horses belonging to the breed,
- inclusion of participating horses to the breeding of Slovak Warmblood,
- statistical evaluation of the success of fathers and lines of horses,
- overall evaluation of 4, 5 and 6-year-old horses.

In the genetic evaluation were analyzed horses, which:

- competed respectively qualified for the finals competition of young horses,
- have both sides confirmed a known origin,
- have available accurate data not only about the origin but also the date of birth, gender, breeder and year of competition

Detailed statistical and analytical processing was carried out in the program SAS (SAS THE SYSTEMS V.8.02).

We used the model equations to analyze factors influencing the monitored indicator – logarithm of ranking of horses that participated in the finals of the championship for young horses:

$$\mathbf{Y_{ijklmn} = \mu + CH_i + PL_j + L_k + P_l + V_m + R_n + E_{ijklmn}}$$

where:

Y_{ijklmn} = evaluated indicator (ranking or logarithm of ranking)

CH_i = fixed effect breeder (i = 1, ... 14)

PL_j = fixed effect breed (j = 1, ... 10)

L_k = fixed effect line (k = 1, ... 13)

P_l = fixed effect gender (l = 1,.... 3)

V_m = fixed effect age (m = 1,.... 3)

R_n = fixed effect year of competition (n = 1, ... 10)

E_{ijklmn} = residual effect

Estimates of genetic parameters and breeding values were performed by BLUP Animal model. Model equations used to estimate genetic parameters and breeding values of competing horses in the finals of championship for young horses:

$$\mathbf{Y_{ijklmno} = \mu + CH_i + PL_j + L_k + P_l + V_m + R_n + A_o + E_{ijklmno}}$$

where:

$Y_{ijklmno}$ = evaluated indicator (ranking or logarithm of ranking)

CH_i = fixed effect breeder (i = 1, ... 14)

PL_j = fixed effect breed (j = 1, ... 10)

L_k = fixed effect line (k = 1, ... 13)

P_l = fixed effect gender (l =1,.... 3)

V_m = fixed effect age (m =1,.... 3)

R_n = fixed effect year of competition (n = 1, ... 10)

A_o = random effect of animal (o = 1,....1699)

$E_{ijklmno}$ = residual effect

When estimating genetic parameters and breeding values were used one - Animal model (for sign - Log Rank) and the arithmetic mean of the adjusted points for every round of the competition (average Breeding Value).

3 Results and discussion

During the monitored period of 5 years, in the long-term competition for young horses took part 1 392 horses, therefrom 448 four years old horses (32.18 %), 485 five years old horses (34.84 %) and 459 six years old horses (32.97 %). To the finals were qualified 761 horses, there from 249 four years old horses, 256 five years old horses and 256 six years old horses.

A similar, but numerous more extensive model of testing is used in Germany. This model described Jaitner and Reinhardt (2003) and Koenen (2002). It evaluates the results of dressage and show jumping competitions, particularly show jumping and dressage competitions for young horses, performance tests for stallions (6 characters) and performance tests for mares (5 characters). Performance tests are conducted in the performance stations.

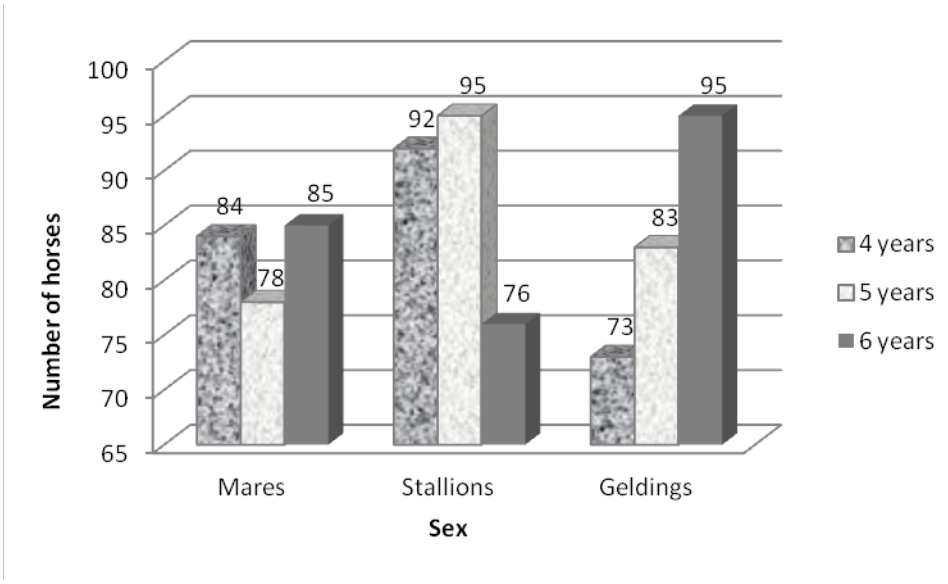

Figure 1 The numerous representation of horses participating in the finals of championship for young horses according to gender and age

From four years old horses there were 84 mares (33.73 %), 92 stallions (36.95 %) and 73 geldings (29.32 %). From five years old horses there were most stallions – 95 (35.98 %), 83 geldings (32.95 %) and least mares – 78 (31.06 %). In the group of six years old horses was the situation opposite to the first case, i. e. most were geldings – 95 (37.11 %), least stallions – 76 (29.69 %) and mares 85 (33.20 %). According to the breed were qualified for the finals 25 breeds of horses, dominated Slovak Warmblood – 224 horses (41.00 %), Holstein horse – 135 horses (24.63 %), Czech Warmblood – 55 horses (10.11 %), Oldenburg horse – 38 horses (7.01 %), Hanoverian horse – 37 horses (6.90 %).

Influence of gender to the horse performance has been identified in the various disciplines of equestrian sport (Gaffney and Cunningham, 1988; Harkins et al., 1992).

In their studies, Whitaker et al. (2008) found that stallions and geldings tend to have better results in competition as mares. Gender is dependent on behavior and controllability of horses, for example mares during the cycle can be difficult to manage in competitions (Viklund, 2010). Although geldings can not be used in reproduction they are easily trainable and their behavior during the competition is more predictable compared to stallions and mares (Pietrzak et al., 2013).

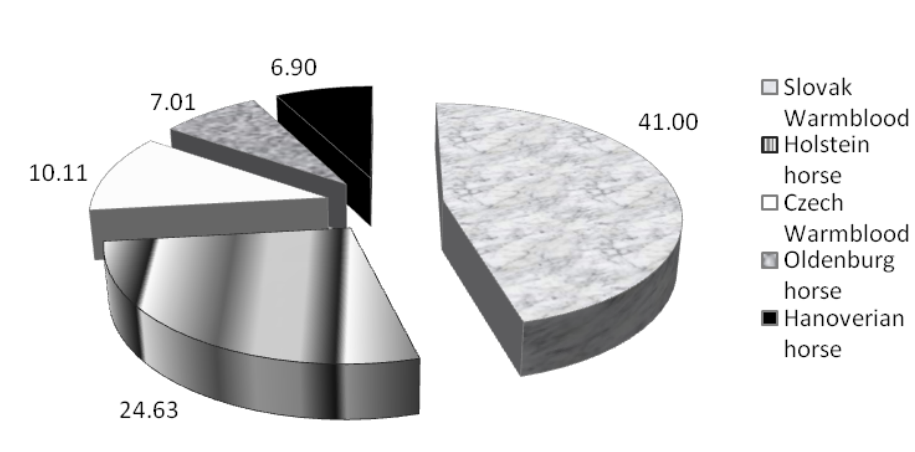

Figure 2 Percentage of horses in the finals competition for young horses considering the breed

In evaluating the success of the fathers of participating horses in the finals of championship for young horses during the monitored period five years in the numerous of 7 or more can be considered as the most successful Holstein stallion Robinson of Ramses line with 24 descendants (5.14%), Trakehner stallion Chavtajm from line Vychodec 15 descendants (3.21 %) and the Bavarian Warmblood Lord Inci Tatus from line Ladykiller xx with 11 descendants (2.36 %). Successful was also Oldenburg stallion Landsieger I, also from line Ladykiller xx with 9 descendants. Ladykiller xx line represented also Hanoverian stallions Lopez and Lombard with 8 descendants. Thoroughbred Marko xx from line Zigeunersohn xx represented as well as Hanoverian stallions 8 descendants. Representatives of the Holstein Warmblood breeds with a number of individuals 7 were stallions Capitol I from line Cottage Son xx and Calvaro by Cor de la Bryere.

In evaluating the paternal line, which descendants have qualified for the finals with the number of 13 or more descendants can be considered as the most successful paternal line Cor de la Bryere with 63 participating descendants (13.49 %), Ladykiller xx with 58 descendants (12.42 %), Ramses with 43 descendants (9.21 %), Cottage Son xx with 23 descendants (4.93 %), and Goldfisch II with 13 descendants (2.78 %). From the analysis of success of fathers and their lines is seen great connectedness of Slovak sport horses breeding to the German breeding. The lines of German sport horses belong to the most successful, as evidenced by the success their subsequent inclusion in breeding Popovici et al. (2014). Breed, age and gender of horses are very important factors that affect later ranking in international dressage competitions on higher levels.

In stud composition the results showed that 75.4% of horses were Warmblood (58.9 % German, 27.1 % KWPN, 14.1 % DWB x SWB), 11.2 % were other sport horses, 7% represented the traditional breeds (48.6 % Lusitano, 28.6 % PRE, 22.9 % Trakehner horse) and 6.4 % was not specified breed. From the population of 761 horses which took part in the finals, we analyzed the fixed effects - factors which could respectively influenced the final ranking of horses. As an auxiliary indicator for the calculation we used the logarithm of ranking which had with final ranking high genetic correlation on significance level < 0.0001, which is highly statistically significant. The age of horse has an impact on performance in competitions. Whittaker et al. (2004) argue that the horses should start participating in competitions at a young age. Ricard and Chanu (2001) and Kearsley et al. (2008) found that young horses compete better in competitions at lower levels compared to older horses. Usually older horses competing at lower levels in the eventing had worst results because they can not stand out in the competition for young horses (Whitaker et al., 2004). In other disciplines was found that the performance of horses increases with the age (Kearsley et al., 2008; Viklund, 2010; Stewart et al.,

2010). It was found that the age of horses in competition affects the performance when interacting with the month of birth (Langlois and Blouin, 1998). The age at first start has significant effect on an ability of horses and their sporting longevity (Sobczynska, 2007). From the analysis of genetic parameters on performance indicators we found that all factors: breeder, breed, line, gender, age of horse and year of the competition influenced the final ranking respectively the logarithm of ranking. But on the level of significance < 0.05, which is statistically significant was only the factor - breeder. Even the value of the F test 1.76 was statistically insignificant (Table 1).

Table 1 Factors influencing the result of horses in the finals competition for young of horses

Coefficient	Influential factors	F rate	Pr > F
Ranking	Breeder	1.53	0.1050
	Breed	0.90	0.5226
	Line	0.99	0.4576
	Gender	2.42	0.0905
	Age of horse	0.02	0.9766
	Year of competition	0.57	0.8183
Log of ranking	Breeder	1.76	0.0473
	Breed	0.66	0.7459
	Line	1.13	0.3359
	Gender	2.20	0.1118
	Age of horse	0.01	0.9971
	Year of competition	0.34	0.9628

– $P > 0.05$; + $P \leq 0.05$; ++ $P < 0.01$; +++ $P < 0.001$

Braam (2011) in his study of Swedish Warmblood found that the genetic correlation between the number of years in the competition, performance and qualitative test of rideability was higher for show jumping (0.65 to 0.69) than for dressage (0.27 to 0.4), it pointed to the fact that there is a connection between the difficulty of competitions and the age. In our correlation analysis was found a high negative correlation (-0.211) between the AVERAGE BV and the logarithm of ranking respectively ranking in a premium competitions (Table 2).

Table 2 Correlation of estimated breeding values (BV) and ranking (R) of horses in the finals competitions for young horses and in premium competitions

Coefficient	BV	Average BV	Log R
BV	1	0.884 <.0001	-0.171 0.0106
Average BV	0.884 <.0001	1	-0.211 0.0010
Log R	-0.171 0.0106	-0.218 0.0010	1

– $P > 0.05$; + $P \leq 0.05$; ++ $P < 0.01$; +++ $P < 0.001$

4 Conclusions

From the analysis of genetic parameters on performance indicators we found that all factors: breeder, breed, line, gender, age of horse and year of the competition influenced the final ranking respectively the logarithm of ranking. But on the level of significance was only the factor breeder. The genetic assessment of monitored horses in tested competitions shows that factors breed and line of horse high statistically influence Log R in particular competition. On the border of statistical support were fixed effects - degree of difficulty in the competition and year of competition. Based on our knowledge, we can conclude that in addition to the above factors has a major impact factor – rider on the ranking in competitions of sport form of testing.

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