Livestock Science 202 (2017) 1–6

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Short communication

Estimation of genetic parameters for linear type traits in the population of sport horses in the Czech Republic

A. Novotná*, A. Svitáková, Z. Veselá, L. Vostrý

Institute of Animal Science, Pratelstvi 815, 10401 Praha-Uhrineves, Czech Republic

ARTICLE INFO

Keywords:
Linear profiling
Genetic correlation
Heritability
Warmblood horses

ABSTRACT

Linear profiling of horses has been used in the Czech Republic for 20 years but without preceding genetic evaluation (predictions of breeding values). The main objective of this study was to estimate genetic parameters of linear profiling of the population of sport horses in the Czech Republic. A linear profiling database was obtained for the period 1997–2015 and it comprised 12 455 horses in total and 25 traits were evaluated. The model equation included fixed effects of gender, horse age, place, classifier*year and individual. Genetic parameters were computed by a single-trait BLUP-AM analysis. The range for heritability coefficients were between 0.05 and 0.31 for linear type traits and between 0.43 and 0.67 for measured traits. Genetic correlations were computed by a two-trait analysis between the evaluated traits and they were in the range of 0.0–0.93. The estimated genetic parameters suggest that a selection programme can be based on the genetic evaluation of linear profiling, which will lead to an improvement in conformation traits according to the defined breeding objectives.

1. Introduction

Horse breeding has a long tradition in the Czech Republic (CZE) but the profitability of National breeding of sport horses is currently very problematic. The most popular breed is a Czech Warmblood which accounts for less than a quarter of the domestic population. The purpose of this breed is to select horses which are noble, easily rideable, with good locomotion and good health, which make them suitable for all kinds of equestrian sport (SCHČT, 2014). The conformation plays an important role in the breeding programme of Horse Breeders Association to achieve better soundness and locomotion and thus, in practical selection, individuals with serious weaknesses and conformational defects should be culled (Saastamoinen and Barrey, 2000).

The current trend of breeding sport horses is a combined selection for conformation and performance, where unfortunately information on sport performance becomes available later in the life of a horse (Duensing et al., 2014). Therefore, the selection of the riding horses is based primarly on indicator traits (such as results of the performance test and evaluations of conformation and gaits). Those are available at a younger age and with higher heritabilities and together with their correlations with selection traits, they are all important components of modern Warmblood breeding programs. Heritability coefficients for conformation traits range from 0.15 to 0.55 (Rustin et al., 2009), 0.09–0.28 (Koenen et al., 1995), 0.05–0.67 (Jönsson et al., 2014) in dependence on the particular evaluated traits.

The linear profiling of horses in the CZE was officially established as routine practice 20 years ago according to the model of dairy cattle. Currently, the genetic value of the sport horse population in the CZE is substantially lagging behind in comparison with the other European populations and is strongly influenced by the imported genetic material (Novotná et al., 2014). Therefore the competitiveness of the products of Czech breeding is low for the time being in comparison with foreign breeding, particularly because there is no comprehensive approach based on the principles of population genetics, while estimation of genetic parameters, prediction of breeding values and subsequent selection of individuals into breeding based on predicted breeding values are missing.

The main objective of this study was to analyse the quality of input databases and estimate genetic parameters of a linear profiling of the sport horse population in the Czech Republic. This a fundamental step towards the development of the linear profiling of genetic evaluation and its introduction into routine practice in the Czech Republic.

2. Materials and methods

2.1. Database description

The database of a linear profiling of sport horses was obtained from

* Corresponding author.
E-mail address: novotna.alexandra@vuzv.cz (A. Novotná).

http://dx.doi.org/10.1016/j.livsci.2017.05.012
Received 13 December 2016; Received in revised form 16 May 2017; Accepted 17 May 2017

Table 1
Comprehensive description of linear traits used for the entry of horses into a studbook.

	Trait	Definition	Scale	
			1	9
1.	Type (Ty)	A complex of body characteristics belonging to a definite breed or commercial group of horses.	markedly atypical	markedly typical
2.	Frame (Fr)	Body length in relation to height at withers.	very short frame	very long frame
3.	Nobleness (Nob)	Harmony of body shapes, head and neck posture, while the whole conformation is in harmonic proportions	serious irregularities in harmony, unusually coarse	very noble to fine
4.	Neck length (NLe)	The length of the neck in relation to its sufficient musclature and strength.	very short	very long
5.	Neck position (NPo)	The height at which the neck is set on the chest.	very low-set	very high-set
6.	Length of withers (LeW)	[a]	very short	very long
7.	Back length (BLe)	[a]	very short	very long
8.	Back shape (BSh)	The topline of the back in relation to well-formed withers and smooth set of loins.	pronounced sway back	pronounced roach back
9.	Length of loins (LeL)	[a]	very short	very long
10.	Shape of loins (ShL)	Side view of the shape of loins in relation to a smooth transition from the back to the croup.	sunken loins	vaulted loins
11.	Croup length (CLe)	The length of the croup from the lumbar to the sacral spinous process.	very short	very long
12.	Croup slope (CSl)	It is characterized by a deviation of the line running between the ilium process and the ischium process from the horizontal plane. The 20% angle of the croup slope is considered as an average.	flat	markedly steep
13.	Croup shape (CSh)	Back view of the shape of the croup while the croup width at hip joints is considered.	rafter and narrow	split croup with robust muscles
14.	Shoulder (Sho)	The angle of the shoulder blade with the arm bone, the length and the oblique angle are also considered	upright and short	sloping and very long
15.	Front pastern (FP)	The angle and the length of the pastern of a front leg.	upright pastern	very sloping pastern with a disposition to flexural deformity
16.	Hind pastern (HP)	The angle and the length of the pastern of a hind leg.	upright pastern	very sloping pastern
17.	Front hoof (FH)	The angle of the front wall of a hoof with the horizontal plane.	very flat	flexural contraction
18.	Hind hoof (HH)	The angle of the front wall of the hoof of a hind leg with the horizontal plane.	flat	flexural contraction
19.	Formation of hind legs (FHL)	The angle of the hind legs at the hock joint, it is described from a side view.	open angle of hocks	sickle hocks
20.	Body width (BW)	The width of the body in the thoracic region at a front view.	very narrow	markedly wide
21.	Stride length of walk (SLeW)	The length of the stride and the hind leg touching the ground in relation to the footfall of the front leg, stride flexibility.	markedly short	very long, flexible
22.	Stride length of trot (SLeT)	The length of the stride at the trot and the hind leg touching the ground in relation to the footfall of the front leg, swing and lift.	markedly short	very long with a pronounced swing
23.	Height at withers (HW)	It is measured with a measuring stick from the highest point of the withers to the ground.	in meters	
24.	Heart girth (HG)	It is measured with a measuring tape behind the shoulder.	in meters	
25.	Cannon bone circumference (CBC)	It is measured with a measuring tape on the left front leg.	in meters	

[a] In official methodology is not definition of this traits, it depends on the subjective evaluation of classifier.

the Central Register of Horses in the CZE. This database comprises sport horse breeds kept or registered the most frequently in the two most important studbooks in the CZE: Czech Warmblood (CW) and Slovak Warmblood (SW). However, various horse breeds can be entered into the studbooks of CW and SW, such as Holsteiner horse, Hanoverian horse, KWPN, Selle Français. In total, 35 breeds were included in the analysis, the most frequent breeds being CW (68%), SW (7.3%), English Thoroughbred (7.1%), warmblood breed (3.7%) and Holsteiner horse (2.2%).

The linear profiling database for BLUP analyses was obtained for the period 1997–2015 and comprised 12,096 horses (359 stallions, 11,737 mares). Each horse had one linear profiling measured only once. In total, 22 linear type traits were evaluated, when the scores 1 – 9 expressed biological extremes of a given trait and three traits of horse measurement expressed in meters were also evaluated (Table 1), in total 25 traits were evaluated. The linear profiling of mares is performed before they are entered into a studbook, which is the most frequently at 3 years of age (61%). Stallions can be characterized by a linear profiling practically any time when they are entered into a studbook but they are described the most frequently at 3 and 4 years of age (23% and 12%, respectively), 16% of stallions are described at an older age of 10–15 years.

2.2. Statistical and genetic analysis

The database comprised a relatively high number of unknown data. E.g. the number of unknown places of evaluation accounted for 33% in the whole database. Place has been defined as a location to which owners bring their horses, and the classifiers performed the linear profiling. Generally, there is only one classifier for all horses in the specific location. The number of evaluations by unknown classifiers was also quite high, 14.9% of evaluations, the most in 1998 (5.11%) and 2009–2013 (6.01%). In total, 17 classifiers were recorded, where each evaluated 37 horses per year on average.

For the estimation of genetic parameters the database was limited so that each effect would have a sufficient number of observations: the stallion would have at least 5 progenies, at least 5 replicates at one place, at least 8 evaluated horses at one place, at least 20 evaluated horses per year, at least 20 evaluated horses per classifier, and the individuals not having all 25 evaluated traits were discarded. Additionally, stallions less than 2 years old, and incomplete data (unknown classifiers and years) were excluded from the database as well. On the other hand, unknown places were kept in the database, but classified as one “type of place”. In the end, 8194 results from 8194 horses were used to estimate the genetic parameters.

Relevance of fixed effects were tested by the least-squares method (SAS, 2005) and genetic parameters were estimated by the AIREMLf90