RESEARCH CONCERNING THE VARIABILITY AND HERITABILITY OF THE CHIEF MORPHOLOGICAL TRAITS OF THE EQUINE POPULATION IN THE AREA OF THE PRAHOVA COUNTY

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Abstract

The heritability, as a characteristic of any measurable feature, is one of the most important indicators concerning the decisions to be made in the process of genetic improvement of the horse population. The studies and the researches undertook by several authors on the horse breeds in our country, although few in numbers and spaced in time, are marking a fairly large amplitude of characters and features inside each population, with the presence of individuals who's performances proving large capabilities of improvement regarding the corporal massivity as well as speed. The analysis of the heritability coefficients and of existing differences between coefficients' values, made by comparing the different studied subpopulations, are leading to the conclusion that the horse population in the area of Prahova county is formed of several structural biological units differentiated from one another by the genotype that forms them and that behaves differently as to the potentiality of the hereditary transmission of different morphological features. When the genetic variability is expressed in terms of heritability coefficient, it results that the highest values within the analysed populations were obtained for the following features: trunk oblique length (h^2=0.43), thorax perimeter (h^2=0.46), thorax width (h^2=0.57), loin width at the hips' level (h^2=0.39), cannon perimeter (h^2=0.43), back length (h^2=0.47), humerus length (h^2=0.44), femur length (h^2=0.47). The stronger determination of the hereditary variation for these features are evidentiating the reduced influence of the environmental factors and the high rate of genetic determination of the above mentioned features' variability. One can consider that the actions of genetic improvement within the analysed lots were carried on in the sense of hereditary fixation of characters that determine body massivity and enhancement of energetic capacity, that the higher genetic variability of this population insures a rapid effect of the selection and a higher probability of success in obtaining body massivity by selection.

Key words: equine, measurable features, heritability, genetic improvement

INTRODUCTION

The local equine population represents the highest quota from the equine total numbers in Romania

The differentiated conditions for breeding these populations, throughout the territory depending on the landscape, of the breeding, selection, exploitation and reproduction methods, have determined, in time, the existence within each of the populations of a group which defines for itself traits and characteristics more or less different from one another, from the point of view of the phenotype as well as the genotype. Studies and research conducted by different authors upon the equine races in our country, although scarce and far between, underline quite a large amplitude of traits and characteristics within each race, there being individuals whose performance reveal great chances of improvement in terms of enhancing the body massiveness as well as movement speed.

Considering the local equine populations in terms of their high rate of variability due to the genotypes that make up these populations, their environmental conditions, their homogenization conditions and the

different genetic values of the reproduction studs, it is necessary to determine separately the heritability of each population; this is an essential condition for the process of genetic improvement of the local equine populations, although up to now it has been a disregarded condition.

MATERIAL AND METHOD

The biological material upon which the assessments have been made has been constituted out of local adult horses from the most representative private studfarms from the Prahova County area. The study involved 23 of the chief morphological characters of the less homogenous populations, disposed on the three geographical areas of the Prahova County: mountain and pre-mountain, hills and foot hills and the plain area.

We assessed the heritability by using the variance analysis method based on genetic resemblances between parents and descendents and the correlations through the co-variance method; the results are presented hereafter.

OBTAINED RESULTS AND DISCUSSIONS

The genetic variant and the heritability coefficients

The results that have been obtained can be found in Table 1.

Table 1. Heritability, standard margins and the limits of reliability for the heritability coefficients

Specification	Heritability	Standard margins for the heritability coefficients s_h^2	Limits of reliability $h^2 \pm 1,64\ s_h^2$
Stature	0.21	0.107	0.038-0.385
Oblique length of the trunk	0.43	0.068	0.319-0.541
Croup height	0.27	0.015	0.246-0.294
Depth of thorax	0.29	0.078	0.163-0.417
Perimeter of thorax	0.46	0.047	0.383-0.537
Width of the chest	0.57	0.134	0.351-0.789
Width of thorax behind the shoulders	0.25	0.103	0.082-0.418
Width of croup around the waist	0.39	0.054	0.302-0.478
Length of the croup	0.22	0.065	0.114-0.326
Cannon perimeter	0.43	0.076	0.306-0.554
Length of the hind ankle	0.56	0.068	0.449-0.671
Length of the fore ankle	0.24	0.037	0.180-0.300
Length of the hind cannon	0.18	0.081	0.048-0.312
Length of the shoulder	0.47	0.132	0.254-0.686
Length of the arm	0.44	0.083	0.304-0.576
Length of the forearm	0.39	0.077	0.264-0.516
Length of the femur (thigh)	0.47	0.046	0.395-0.545
Length of the shin bone	0.26	0.085	0.121-0.399
Length of the head	0.31	0.019	0.279-0.341
Width of the eye sockets	0.21	0.026	0.168-0.252
Length of the neck	0.50	0.172	0.218-0.375
Body weight	0.32	0.034	0.265-0.375

By examining the heritability coefficients for the majority of analyzed morphological traits it is clear that they show different degrees of genetic determination, as a result of medium genotypic inter-relations belonging to each trait and the genotype variability which makes up the different studied animal groups. Therefore, the heritability coefficient for the stature (h^2=0.21) indicates a weak degree of hereditary transmission, as well as for the length of the loin (h^2=0.22), the length of the cannon in the back (h^2 =0.18) and the width of the head on the eye sockets (h^2=0.21).

The low genetic determination quota of these traits reflect, on one hand the high variability of the female material and on the other hand the low genetic variance between

the male reproducers. The influence of the environment on the determination variance of these traits is high, from 78% to 82%; this is a situation which classifies these traits in a category with a weak hereditary transmission.

The body weight fits in, according to the heritability coefficient, the category of traits with a weak – mediocre genetic determination (h^2=0.32), as well as the depth of the thorax (h^2=0.29), the width of the thorax at the back length (h^2=0.25), the length of the whistle bone (h^2=0.26) and the length of the head (h^2=0.31). These data can yield in a guarantee that the set values of the phenotype correspond, for the most part, with the constituent genotype potentiality.

The environment, as for these traits, participates with a reduced quota in determining the total variance, fact which will determine different bearings, methods and managerial systems during the genetic improvement and selection process against traits with a weak hereditary transmission.

These considerations are valid, especially for the following traits: the oblique length of the trunk (h^2 = 0,43), the thorax perimeter (h^2=0,46), the width of the torso (h^2=0,57), the length of croup of the hips (h^2=0,39), the cannon perimeter (h^2=0.47), the length of the shoulder (h^2=0.47), the length of the arm (h^2=0.44), the length of the femur (h^2=0.47). An examination of these values yields a match between the assessments done based on the phenotype and the estimates on the variability and value h^2 for these traits. A stronger determination of the hereditary variance for these traits reveals a reduced influence of the environmental factors and a high quota of genetic determination for the variability of said traits. It is possible to consider that the genetic improvement actions within the analyzed samples were conducted towards a hereditary fixation of the traits which determine bodily growth and an increase in the energy capacity, that the elevated genetic variability within this population ensures an hastened effect of selection and an increase in safety for obtaining the effects of selection concerning bodily growth. Using the values of its proper phenotype for assessing the genotype is efficient.

Phenotypic correlations between different morphological characteristics

Figure 1 and 2 present the phenotypical correlations between the chief morphological traits within the studied equine population.

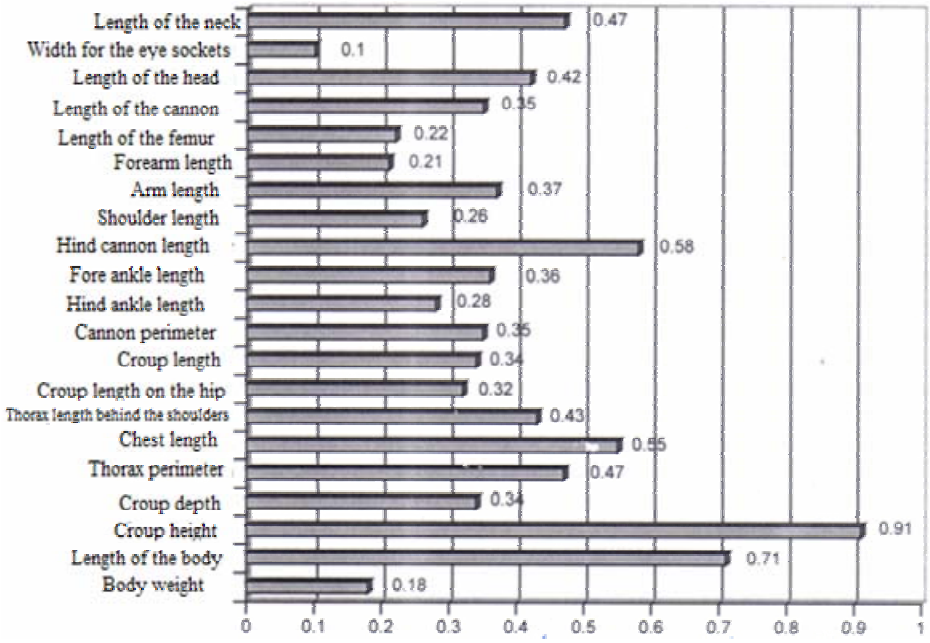

Figure 1. Phenotypical correlations between the stature and chief morphological traits

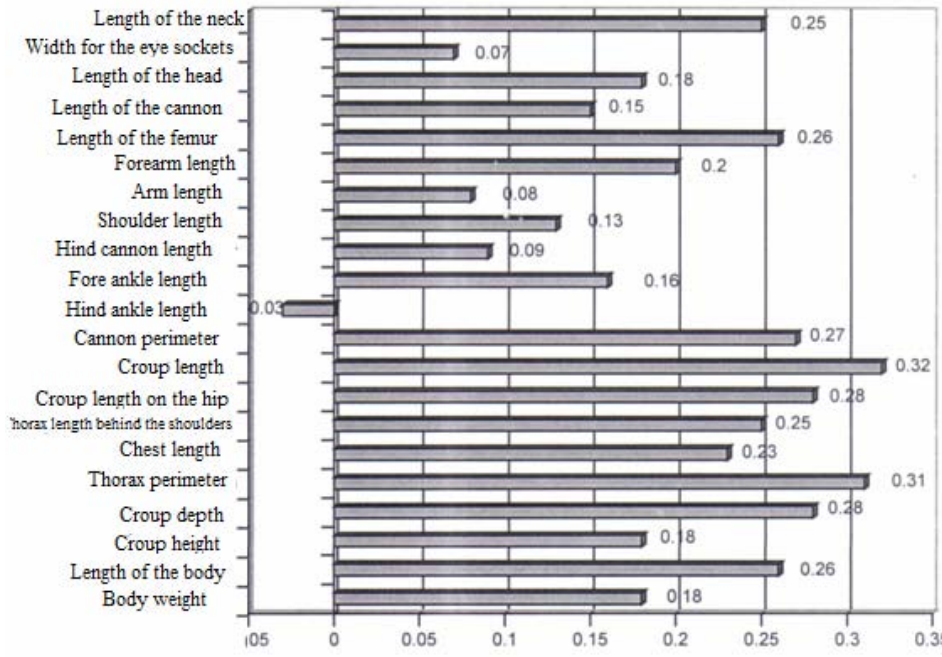

Figure 2. Phenotype correlations between the weight of the body and the chief morphological traits

By analyzing the values that were obtained it can be noticed that the stature is in a positive correlation with all the assessed morphological traits. Positive and tight values can be maintained for the phenotype correlations between the stature and the length of the body (r_p = 0.71), the height of the croup (r_p = 0.91), the width of the chest (r_p = 0.55), the thorax perimeter (r_p = 0.47), the length of the neck (r_p = 0.47), which means that during selection it is possible to obtain the desired growth enhancement of the population by making use of a phenotype selection.

The phenotype correlations between the weight of the body and the other morphological traits are less intense, but mostly positive. Some of the body dimensions, such as: the length of the body (r_p = 0.26), the depth of the thorax (r_p = 0.28), the length of the croup (r_p = 0.32), the cannon perimeter (r_p = 0.27), these correlate positively and quite intensely with the weight of the body; during selection it is possible to act for the purpose of body weight enhancement, acting especially upon the fore and back train.

The results we have obtained agree with some of the data found in specialized literature obtained by V. Ujică, E. Călinescu, Gh. Mărginean, N. Marcu, Gh. Mureşan et c. and they can be further utilized in an equine genetic improvement program from the studied area.

CONCLUSIONS

By examining the h^2 values for the main body dimensions, it generally follows that the oblique length of the trunk, the thorax perimeter, the cannon perimeter, the width of the chest, the length of the shoulder, arm and femur, the width of the croup at the hip level are the traits that present a strong degree of hereditary transmission, a distinctly important fact for the purposes of realizing an accelerated rhythm for selection towards improving upon the bodily format and enhancing the bodily weight.

The analysis of the heritability coefficients and of the existing differences between their values done by comparing the

studied sub-populations, leads to the conclusion that the equine populations from the are of the Prahova County is made up of structural biological units which differentiate from one another due to the genotype they make up and behave differently so far as the potentiality for hereditary transmission of the different morphological traits is concerned. This aspect determines a differentiated approach of the procedures and means for genetic improvements, but also of the technical – managerial measures used to direct the technological factors of exploitation.

By correlating the values of the phenotype variance with the genetic variance, it follows that for most of the studied population the large phenotype variability does not also reflect a large genetic variability.

By expressing the genetic variability through the terms of the heritability coefficients it follows that the highest values from the analyzed populations belong to the following traits: the oblique length of the trunk, the thorax perimeter, the width of the croup at the hip level, the width of the chest, the cannon perimeter, the length of the shoulder and arm, the length of the femur.

The following aspect can be outlined, also as a result from the analysis of medium values and the morphological trait variability: the different analyzed groups from within the equine population (Prahova County area) have variable values of the genetic determining quota for the dimensions we have studied, fact which determines measures, actions and methods in accordance with the management of the genetic resources of this species.

REFERENCES

[1] Călinescu E., Ujică V., 1982 – Buletin de L' Académie des Sciences Agricoles et Forestières, nr.11, p. 159-169 and no.13, p. 221-231, Bucharest.
[2] Călinescu E., Ujică V., 1982 – Producing a new type of utility horse for the mountain area: "Bucovina Horse". Research in support of production, MAIA, Bucharest.
[3] Georgescu Gh., Ujică V., Lungulescu Gh., Marcu N., 1982 – Equine growth technology and equitation . Ed. Did. şi Pedagogică Bucharest.
[4] Georgescu Gh., Paraipan V., Ujică V., Blaga L., Balan S., 1990 – Equine growth technology. Ed. Ceres, Bucharest.
[5] Grünberg Rica, Călinescu E., 1958 – Research concerning a rational horse labor. Anale ICZ, vol. XV, Ed. Agro-Silvică de Stat, Bucharest.
[6] Iacob Lelior, 2004 – Contributions to the study of the equine populations in the area of the Prahova County. Doctoral Thesis - UŞAMV Iaşi.
[7] Mărginean Gh., 1991, Equitation and equine sports. USAMV, Bucharest.
[8] Popescu – Vifor Ştefan, 1990 – The genetics of domestic animal populations – Ed. Ceres, Bucharest.
[9] Schwark H.J., 1984 – Pferde-Zucht, Berlin.
[10] Ujică V. şi col, 1988 – The rase improvement effect upon the equine populations in Moldova, vol. 31, seria Zootehnie – Veterinary Medicine, I.A. Iaşi.
[11] Ujică V. şi col., 1986 – The Bucovina Horse – a new utility type for the mountain area. Animal growth Magazine, no.5, Bucharest.