ESTIMATION OF GENETIC DISTANCE AND THE DISTINGUISHING FACTOR OF THE HORSES IN NORTH SUMATRA THROUGH MORFOMETRIC ANALYSIS

Halitopan Kaban, Hamdan, TH Wahyuni, N Ginting, and AHDaulay

Animal Production Study Program, Faculty of Agriculture, Universitas Sumatera Utara, Medan 20155
E-mail : khalitopan@gmail.com

Abstract. This research objectives to investigate the distance of genetics and differentiator factor of the horses in four District in North Sumatra. This research was conducted in Karo District (60 heads), Humbahas District (77 heads), Tapanuli Utara District (52 heads) and Samosir District (42 heads) at July 2016. The analysis used were descriptive analysis, discriminant analysis, canonical analysis, principal component analysis, genetic distances and filogenic tree. The observed variables in this study were shoulder height, hip height, hip width, body length, chest circumference, chest and chest width, and the variables that distinguish the horse in term of size were hip height and in terms of shape was the width of the chest. The nearest genetic distance was the horse between Karo and North Tapanuli District (0.869) and the horse that had the farthest genetic distance were horses in Karo District with horses in Samosir District (14.539). Based on the results of morphometric measurements of horses in this study, in order to obtain heterosis, it was expected to cross between horses in Karo District and horse in Samosir District.
Keywords: morphometric, discriminant analysis, canonical analysis, principal component analysis, genetic distance

1. Introduction

Horses known as monogastric animals have considerable benefits for human life. Horse livestock can be an alternative provider of meat and has considerable potential as one source of food that has a very high protein content, as cattle and horse can also be used such as horse racing.

To increase the production of livestock one of which is considered genetic factors; livestock with close kinship may be expected to be less likely to increase heterosis in its crosses. So before mating, one has to note the genetic distance between animals. It aims to get a superior or beneficial nature. Livestock productivity is enhanced through genetic improvement by selection and breeding and through environmental improvement Lasley [1].

Morphometrics is a study concerned with variations and changes in the shape (size and shape) of the organism, including the measurement of the length and analysis of the framework of an organism. The morphometric study is based on a set of measurement data representing a variety of horse forms and sizes.

2. Materials and Method

This research was conducted in Samosir District, North Tapanuli Regency, Humbang Hasundutan Regency and Karo Regency in July 2016.The materials used are horses that have grown and adult body as much as 231 heads.The tools used in this research was tape measure (cm) and measuring stick (cm), stationery and sheetdata used to record observations and measurements, Laptops, SAS (Statistical Analysis System) software and MEGA are used to analyze data.The measured body parts of the horse are shoulder height, hip height, hip width, body length, chest circumference, in chest, and chest width. The entire body size is measured in cm.

3. Results and Discussion

Table 1. Average, standard deviation and coefficient of horse diversity

Peubah	District			
	Karo (KK %)	Humbahas (KK %)	Taput (KK %)	Samosir (KK %)
TP	154.48±3.69 2.38	133.49±3.01 2.25	153.63±2.45 1.59	131.41±2.26 1.71
TPi	154.36±3.64 2.35	131.93±3.22 2.44	153.86±2.40 1.55	130.00±2.39 1,83
LPi	50.90±3.16 6.20	42.67±2.52 5.90	50.05±2.78 5.55	41.41±2.99 7.22
PB	161.33±4.01 2.48	135.62±2.23 1.64	160.26±10.07 6.28	133.68±2.94 2.19
LiD	166.36±6.15 3.69	148.18±4.96 3.34	164.46±9.60 5.83	146.21±2.65 1.81
DD	66.03±2.55 3.86	52.92±4.62 8.73	66.11±2.47 3.73	50.92±3.19 6.26
LeD	30.46±2.93 9.61	28.48±2.76 9.69	32.01±1.56 4.87	28.21±2.06 7.30
N	60	77	52	42

Ket: TP= High of Shoulder
TPi= hip height
LPi= hip width
PB= Body length
LiD= Circumference of Chest
DD= In Chest
LeD= Chest width

3.1. The Differentiator of Horses

Table 2. The structure of the differentiating variables of the Combined Horse

Variable Body Size	Factor 1 (Size)	Factor 1 (Size)

High of Shoulder	0.968	-0.053
hip height	0.970	-0.050
hip width	0.861	-0.079
Body length	0.922	-0.053
Circumference of Chest	0.872	-0.004
In Chest	0.920	0.018
Chest width	0.208	0.977

Based on the results of the Principal Component Analysis (PCA) method above, the data on the height variable of the shoulder, hip height, hip width, body length, chest circumference, and chest are strongly correlated, but notstrongly correlated to chest width, and the most distinguishing variables in terms of size (Factor 1) are hip height (0.970), whereas in terms of shape (Factor 2) is the width of the chest (0.977). The estimation is based on the high eigenvalue of the hip height and chest width.

3.2. Horse Gear Analysis

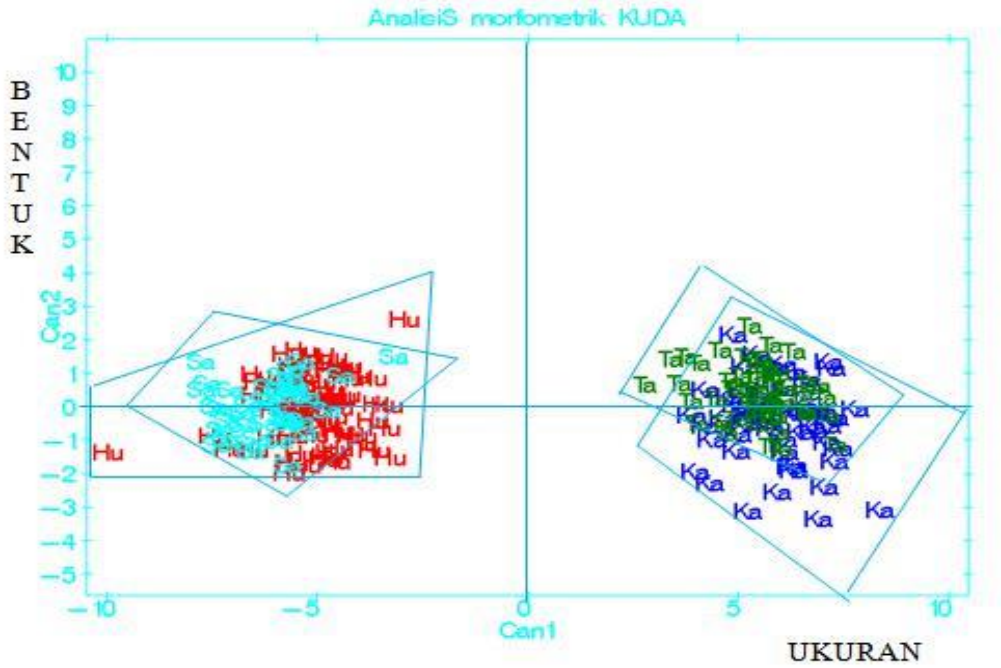

Figure 1. Horsepower Analysis

Gesture analysis based on the measurements of that body describes the interregional separation shown in Figure 1. Afifi and Clark [2] states that the data plot discriminant analysis results can be used illustrates the maximum that may occur between group tested. Results of analysis on 3.show is in Kab. Karo and Taput clumped to the right, and the horse in Kab. Humbahas and Kab.Samosir on the left side. The more renggangnya crowd indicates uniformity of body size in a Regency and horse body size between districts. Horses in Kab.Karo and adjacent, this indicates that in both districts have uniform size of the variables- observed variables. Kab.HumbangHasundutan has a dispersal map adjacent to Kab. Samosir, these results indicate that morphometric measurements of horses between these districts interpret the presence of adjacent sameness uniformity.

According to Gaspersz[3] basically phenotypic diversity is a diversity that can be observed caused by the existence of genetic diversity and environmental diversity. Another source of diversity is the diversity that arises Figure 1. Horsepower Analysis due to the interaction between genetic factors with environmental factors

Another factor capable of causing diversity and uniformity according to Wiley[4] is that genetic diversity can occur due to mutation due to selection, cross-breeding or natural disasters that can result in the loss or drift of genes.

Table 3.Fisher's discriminant analysis

	District			
variables	Karo	Humbahas	Tapanuli Utara	Samosir
High of Shoulder	11.48	9.94	11.41	9.77
hip height	12.01	9.99	11.99	9.82
hip width	4.80	3.97	4.71	3.82
Body length	5.11	4.33	5.04	4.28
Circumference of Chest	1.68	1.62	1.61	1.62
In Chest	5.71	4.36	5.65	4.17
Chest width	-3.98	-2.75	-3.64	-2.62
	-2618	-1899	-2584	-1835

Based on Table 3 shows that the value of the highest variability uniformity comes from Kab.Karo and Kab. The samosir is -2618 to -1835, and the lowest uniformity of the variables is in Kab. Karo-2618 with Kab.North Tapanuli -2584. According to Safitri [5] size variations occur between different species, even in the same species. Several factors limit the size and shape of animals, including genetic conditions, nutrient supply and toxicity.

Determination of Estimation of Genetic Distance and Intermediate Dendogram

Table 4.Matrix of horse's genetic distance

District	Humbahas	Karo	Samosir	Tapanuli Utara
Humbahas	0.00			
Karo	12.899	0.00		
Samosir	1.315	14.539	0.00	
Tapanuli Utara	11.240	0.869	13.695	0.00

Based on the distance matrix above, the distance between horses in Kab.Karo and horses in Kab. North Tapanuli is 0.869, this result indicates that horses in both of these regencies have the nearest genetic distance. This is possible because there has been an outside cross between horses in both districts. The genetic distance of horses in Kab.Karo with Kab.Samosir of 14,539, this result states that horses in these two districts have the farthest genetic distance. This is probably due to the absence of outside crosses between the two regencies.

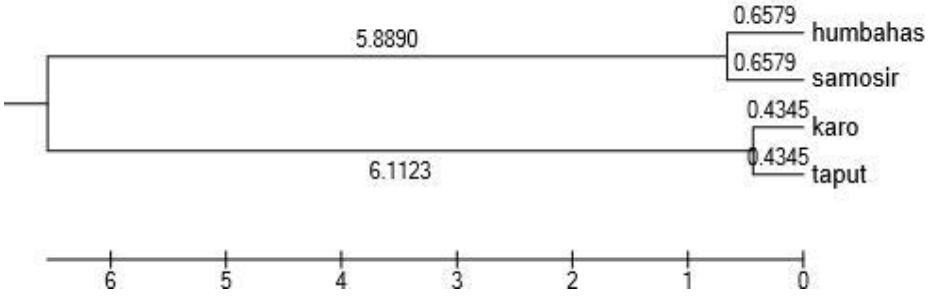

Figure 2.Dendogram tree

Dendogram shows that the kudayang is in Kab. Karo and Kab. North Tapanulihave close kinship ties. It can be concluded that if there is a cross between horses in these two districts, it will not provide significant quantitative development, this is possible because of the small chance of heterosis(the quantitative measurement of the average superiority of the child against the average parent) on the result of crossing between the two in the future. Horses that have the most distant kinship ties are horses in Kab. Karo with horses in Kab.Samosir, it is estimated that cross-horse crossing in these two districts will provide significant quantitative developments, this is possible because of the greater chance of heterosis in the crossing results between the two in the future.

4. Conclusions

From this study it is found that in each regency in North Sumatera has a morphometric size that varies, and the most distinguishing variables that distinguish horses in terms of size (Factor 1) are hip height and shape (Factor 2) is the width of the chest. The highest diversity coefficient was found in horses in Kab. HumbangHasundutan and the lowest is found on horses in Kab. Taput. The nearest genetic distance of the horse is a horse between Kab. Karo and Kab. North Tapanuli, and the horse that has the farthest genetic distance is a horse in Kab. Karo with Kab.Samosir. Based on the results of horses morphometric measurements in this study in order to obtain heterosis, it is expected to cross the horses in the district. Karo with horses in Kab.Samosir. However, it is necessary to conduct more direct and in-depth molecular research in the future to obtain more accurate results.

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