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SELECTION AND BREEDING VALUE ON TROPICAL HORSES: CASE STUDY ON POTENTIAL BREEDING DEVELOPMENT ON INDONESIAN RACE HORSES

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Abstract

The study aimed at estimating variance components of racing ability traits in Minahasa racehorses as a contribution to defining the breeding value for this population. Data were provided by Indonesian Horse Racing Assosiate/PORDASI (1) contained more than 150 placings at finish by horses running in 907 races from 2010 to 2017. Age of horses ranged from 2 to 7+ years, and the distances were from 600 to 1800 m. Speed of horses was derived from the distance of racetrack in the racing time of the winner due to only the horse wins finish time was recorded. Horses were from stables, from private breeders and from foreign breeding. Speed and Variance components were estimated by the descriptive and animal genetics measurement method. Statistical analysis accounted for fixed effects of year, age, race, sex and weight carried, and for the random effects of rider, permanent environment, and animal additive genetics. Speed rate was 14.62 m/s to 15.45 m/s or around 66 km/h (approx.) and heritability coefficients were 0.22 to 0.82 and repeatability 0.16 to 0.69, respectively. The highest breeding value (PBV) = 0.09 m/s of male H and MPPA (Most Probable Producing Ability) in the population = 0.19 m/s (individual B010) where the average MPPA value of the entire population is = 0.0239 m/s.

Key words*: EBV (breeding value), Minahasa, MPPA (Most Probable Producing Ability), race horses, speed traits.*

INTRODUCTION

As an animal of high economic value racehorses were maintained for the purpose of competing in a race, so that the development of the horse racing industry was inseparable from the improvement of the genetic quality of racehorses in every breeding program in each country (Edwards, 1994), no exception in Indonesia (Ambo et al., 2014). For maintenance in Indonesia racehorses are a pride for the owner (Oroh, 2004), because in addition to the advantages in terms of personal satisfaction can also provide a real advantage in the form of obtaining prizes on the achievements achieved by the racehorse (Sabeva, 2000a). Unfortunately, the development of the racehorse industry in Indonesia is not accompanied by efforts to improve the genetic quality of horses (Astuti et al., 2011). Cross pure breeds superior stud horses imported from out of the country, generally not accompanied by a proper and directed selection program, make racehorses in Indonesia less competitive in the international arena (Forum Sandalwood Indonesia, 2009). Australian horse breeds are mated to local pony females, producing local racehorses. The term local racehorse, known as G1 for the first, second (G2) races, and so on has a great posture (Soehardjono, 1990). Cross-produced offspring became the main prerequisite to take part in the classic horse racing held in Indonesia (Pordasi, 2003). Therefore, knowing the genetic potential of Minahasa (Indonesia) horses is a very strategic source of information to develop racehorses in Indonesia (Takaendengan et al., 2011). Racehorse speed performance according to Tolley et al. (1983) is an expression of a horse's running speed at a certain distance. Therefore, horse racing time records can be used as one of the best parameters for measuring the appearance of genetic quantitative properties of a superior mares/mares, so analysing the trait of running speed can be used as the main variable in selecting quality racehorse studs (Langlois, 2007). The selection method is a breeding step to improve the quantitative nature of the running speed of Indonesian racehorses, so that the characteristics of the running speed of Minahasa racehorses can be improved (Makalalag, 2014). The classic problem in trying to improve the genetic quality of racehorses is currently due to the lack of breeding efforts based on the results of correct scientific studies from horse keepers in Minahasa (Takaendengan et al., 2011). Based on this problem, the authors wanted to conduct research to obtain information on the potential advantages of phenotypic and genetic racehorses in Minahasa based on horse running speed traits sourced from a collection of horse racing results organized by the Equestrian Sports Association North Sulawesi (PORDASI, 2003). This study was conducted to see and get an idea of how much genetic potential of Minahasa racehorse speed traits as basic information to make changes to the existing racehorse population through the selection stage. Breeding value is expected to be the initial benchmark of conducting a selection program based on males or mares selected as the parent stock of seedlings of superior racehorses in Minahasa.

MATERIALS AND METHODS

In this study, the time record of horse racing from 8000s of Indonesian racehorses that finish provided by the Indonesian equestrian sports association for the last 20 years. The information available for each horse includes gender, age, brood, body size, fur colour and breed. Horse pedigree information covers at least 3 generations (Takaendengan et al., 2011) and data from interviews with various parties involved in the championship. All of the horses recorded are from Minahasa (North Sulawesi). The available finish time data is processed to get the running speed figures, first analysed to get a descriptive picture of the spread of racehorse speed in Minahasa. Using the Paternal Half-sib Correlation method according to Becker (1994) obtained heritability (h^2) then continued by looking for breeding value (*EBV*) from Kennisnet (2017) and interclass correlation repeatability (r) to get the most probable producing ability (*MPPA*) value according to Hardjosubrorto (1994).

$$h^2 = \frac{4\sigma_s^2}{\sigma_s^2+\sigma_w^2};$$

$$EBV_{mass\ selection} = h^2 \times [P - P_{mean}];$$

$$r = \frac{\sigma_w^2}{\sigma_w^2+\sigma_e^2};$$

$$MPPA = \bar{P} + \left[\frac{nr}{1+(n-1)r}\right][\bar{I} - \bar{P}]$$

Calculation and tabulation are performed manually by using Microsoft Office Excel and continued analysis of variance using SAS statistical applications. For the estimation of repeatability value, the data of foals (individuals) who have a record finish time of 5-6 times were used. The uniformity of the sample count is intended to avoid significant differences in the value of k (coefficient with number of children per male) resulting in irrelevant comparisons between individuals (half-siblings) (Becker, 1968).

RESULTS AND DISCUSSIONS

Mean, Standard Deviation and Coefficient Variation of Racehorse Running Speed in Minahasa based on Horse Studs

Based on the results listed in Table 1, shows that the average speed ranges from 14.62 ± 0.79 m/s to 15.37 ± 0.63 m/s or comparable to a speed of 52 km/h up to 55 km/h. Whereas, the top speed of the racehorse measured is 23.21 m/s and the lowest speed is 9.35 m/s with the average speed of the race being 15.04 ± 1.4 m/s.

Table 1. Description of Minahasa horse running speed (m/s) based on Horse Studs

Studs	Progeny (n)	Mean (m/s) ± SD	Max. (m/s)	Min. (m/s)	CV (%)
A	233	15.09 ± 0.75	19.89	9.35	4.98
B	165	14.62 ± 0.79	18.22	13.23	5.39
C	137	15.14 ± 0.63	16.31	10.43	4.15
D	132	15.37 ± 0.62	16.99	13.97	4.01
E	75	15.12 ± 1.25	16.64	9.75	8.27
F	56	15.02 ± 0.50	16.33	14.22	3.30
G	49	15.13 ± 0.35	15.88	14.41	2.34
H	52	15.45 ± 1.34	23.21	11.31	8.67
I	49	14.90 ± 0.55	16.33	12.90	3.71
J	46	15.30 ± 0.56	16.92	14.00	3.68
K	32	15.07 ± 1.13	16.77	11.33	7.53
L	35	15.15 ± 0.86	16.32	11.36	5.68
M	35	15.25 ± 0.53	16.66	14.12	3.49
N	28	15.22 ± 1.55	16.14	9.60	10.18

Males A to N are the order of males used in heritability analysis where the horse's real name is not written for privacy reasons.
m/s = meter per second; SD = standard deviation; max. = maximum; min. = minimum; CV = coef. of variation.

The average running speed of horses is higher when compared to the average speed of pure and thoroughbred Arabian racehorses in the Netherlands and Bulgaria reported by Schurink (2009); Sabeva (2000) was 13.80 m/s and 12.90 m/s. However, this result was lower than the average speed of a Turkish Thoroughbred racehorse of 15.30 m/s (Ekiz &Koçak, 2007) and the Brazilian quarter horse speed of 17.10 m/s (Corrêa &Mota, 2007). Many factors affect the running speed of racehorses such as the influence of horse breeds and nations, the climate of a country, the type of track/race and can be caused by variations in methods and types of data collection. The number of competitions conducted by each country, race recording equipment, and selection of racehorses are cited as factors that can also affect the running speed of horses (Ruhlmann C. et al., 2009). The "x" factor of jockeys and race business sometimes makes the estimation of the ability of racehorses in running to be biased (Bakhtiari & Kashan, 2009). The type of racehorse in Indonesia that was maintained in Minahasa, is generally the result of a cross between thoroughbred horses and local Indonesian horses over the past few decades (Komisi Peternakan & Kesehatan Veteriner, 2000). The lack of a targeted selection system of the running speed of racehorses developed in Indonesia therefore study data shows there was still a high genetic diversity in the trait of running speed that was between 2.34 to 10.18 percent (Martojo, 1992). The genetic diversity of Minahasa racehorse population shows the potential for future selection which was an opportunity to conduct breeding programs to obtain males or offspring that have superior genetic qualities based on running speed traits.

Estimating The Breeding Value Of A Stud Racehorse Running Speed Traits

Obtained the heritability value of the speed of running speed of a racehorse (Table 2), based on the method of correlation of half-siblings from low to high, which obtained male B has the lowest heritability value of 0.07 and male N has the highest heritability value of 0.48. According to Sulastri and Hamdani (2013), there are four males included in the low classification (0.0-0.1) and seven males in the medium classification (0.1-0.3); While the three males (K, M, and N) are included in the high classification (>0.3). Male H is the horse that has the highest EBV value (0.09) although the heritability value of this horse is relatively moderate (0.21). Meanwhile, compared to K males who only ranked 9th (0.01115), but had a relatively high heritability value (0.34). This is natural because according to Bailey, E (2014); Takaendengan et al. (2011); heritability value is not an absolute value but is the result of estimating the genetic potential of a trait in a population that is estimated or suspected based on measurable external traits (quantitative properties).

Table 2. Heritability of racing speed traits and estimated breeding value of Minahasa horse

Studs	h^2	S.E (h^2)	EBV	Rank
H	0.21	0.56	0.09	1
N	0.48	0.82	0.08	2
M	0.35	0.71	0.08	3
J	0.22	0.64	0.06	4
L	0.29	0.78	0.03	5
G	0.25	0.57	0.02	6
D	0.07	0.31	0.02	7
E	0.14	0.45	0.01	8
K	0.34	0.79	0.01	9
C	0.08	0.32	0.01	10
A	0.05	0.22	0.00	11
F	0.19	0.53	-0.00	12
I	0.20	0.62	-0.03	13
B	0.07	0.26	-0.03	14

Males A to N are the order of males used in this analysis where the horse's real name is not written for privacy reasons.
m/s = meter per second.

Looking at the results of the analysis of breeding values based on the performance data of individual males, it was obtained the result that horse H with EBV of 0.09 has the best genetic potential as a stud. The increase of 0.09 m/s in the following breeds certainly gives an advantage in terms of genetic quality that has an impact on the economic value of breeders (Dakhlan & Sulastri, 2002). When compared to the average population of only 0.03 m/s. The superior quality of males according to Hardjosubrorto (1994) puts the selected breed of horses in a more respectable position in the population.

Repeatability and Individual Most Probable Producing Ability

The repeatability value of the racing speed trait of the racehorse in Minahasa was explained in Table 3. Based on the results of this study, some offspring of male J have higher genetic ability (R = 0.69) than some existing horse breeds, while male N has the lowest R value (0.15). The group of males with high R values are males C, I and J; medium male H and the rest of males A, B, F and N are included in the low classification.

Table 3. Repeatability of Racing Speed Traits and Most Probable Producing Ability of Minahasa Horse

Progeny	Avg Progeny (m/s)	Studs	R	S.E (R.)	MPPA (m/s)	Rank
B010	15.80	B	0.16	0.13	0.19	1
C007	15.52	C	0.42	0.20	0.16	2
J001	15.48	J	0.69	0.37	0.13	3
B013	15.42	B	0.16	0.13	0.13	4
A009	15.73	A	0.19	0.13	0.12	5
B006	15.35	B	0.16	0.13	0.12	6
B007	15.33	B	0.16	0.13	0.11	7
B011	15.30	B	0.16	0.13	0.11	8
C003	15.39	C	0.42	0.20	0.11	9
C004	15.38	C	0.42	0.20	0.11	10
C001	15.37	C	0.42	0.20	0.10	11
B008	15.24	B	0.16	0.13	0.10	12
B002	15.18	B	0.16	0.13	0.09	13
A007	15.51	A	0.19	0.11	0.08	14
H003	15.67	H	0.36	0.29	0.08	15
N001	15.74	N	0.15	0.30	0.08	16
F001	15.41	F	0.19	0.26	0.07	17
B003	15.08	B	0.16	0.13	0.07	18
A003	15.46	A	0.19	0.11	0.07	19
N002	15.66	N	0.15	0.30	0.07	20
I002	15.05	I	0.44	0.35	0.07	21
H002	15.63	H	0.36	0.29	0.07	22
B005	15.02	B	0.16	0.13	0.06	23
B009	15.01	B	0.16	0.13	0.06	24

[1]Males A to N are the order of males used in this analysis where the horse's real name is not written for privacy reasons.
[2]m/s = meter per second.

The MPPA (Most Probable Producing Ability) analysis in table 4 shows a horse's ability to maintain its genetic appearance continuously (Ardika et al., 2015). From the results of the study, it was seen that individual B010 has the highest MPPA value compared to other racehorse populations of 0.19 m/s. This indicates that B010 horses that are descendants of male B are thought to be able to inherit the genetic superiority of running speed properties by 0.19 meters per second faster in the next generation while describing the superiority of the brood of male B. Therefore, based on the results of the individual MPPA value, it is expected that the next generation racehorses will have a speed increase in accordance with the potential value of excellence measured today (Warwick et al., 1987). Although this is not absolute because it may be that the value is also influenced by the female/brood genes of the B010 mare. The accuracy of the horse's potential excellence based on the results of this analysis is highly dependent on the environmental factors of its successor (Ensminger, 1962; Blakely & Bade, 1991).

CONCLUSIONS

Speed rate was 14,62 m/s to 15.45 m/s or around 66km/h (approx.) and heritability coefficients were 0.22 to 0.82 and repeatability 0.16 to 0.69, respectively. The highest breeding value (PBV) = 0.09 m/s of male H and MPPA (Most Probable Producing Ability) in the population = 0.19 m/s (individual B010) where the average MPPA value of the entire population is = 0.0239 m/s.

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