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The variation of phenotypics Bali cattle in Bali Province, Indonesia

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Abstract
Phenotypic of variation is required for selection effectiveness, while the artificial insemination program was recommended to accelerate the improvement of genetic quality. This study was carried out used of 412 heads of male and famale Bali cattle at “Sentra Peternakan Rakyat (SPR) Jaya Giri”, at Regency of Badung, Bali Province, Indonesia. The variables measured in this studi were body length, body height, and chest girth. The results of the study were grouped by age/teeth. Further analyzed descriptively. The results showed that variations phenotypic of Bali cattle at “People Husbandry Business Center (SPR) of Jaya Giri”, at Regency of Badung, Bali Province were homogen. It was concluded that for increasing population diversity of Bali cattle, it can be done by bringing new livestock populations to the "SPR Jaya Giri", at Badung Regency, Bali Province, so that the selection program was effective.

Keywords: Bali catlle, body length, body height, chest girth

Introduction
Bali cattle (*Bos sondaicus*) is a well-known native germplasm of Indonesia, because of its uniqueness and superiority compared to other types of cattle in Indonesia, so Bali cattle can be said to be a very valuable asset owned by Indonesia (Bidura, 2019) [1]. Bali cattle have many advantages not possessed by other cattle breeds in the world. Some prominent advantages of Bali cattle are calving interval which can reach 12 months with a calving rate of 70% (Wirdahayati and Bamualim, 1994) [15], high tolerance or adaptation to the environment (Djagra *et al*., 2002) [2], high percentage of carcasses, with high quality carcasses (Gunawan *et al*., 2004) and their resistance to ticks (*Boophilus sp.*), as well as high worms (Wijono and Mas'um, 1981) [11].

This valuable germplasm must also be preserved for purity, so that its superior qualities are not lost. However, the performance of Bali cattle, especially their body weight tends to decrease from year to year (Kesuma *et al.*, 2019) [5]. This was allegedly due to a decrease in genetic quality (Warmadewi *et al*., 2020) [14]. If this happens continuously and runs for a long time, it is feared that Bali cattle will be threatened by its existence (Warmadewi *et al*., 2019) [13].

Several attempts have been made to improve the genetic quality of pure Balinese cattle on the island of Bali, Indonesia. One effort that can be done is by way of selection, namely selecting male and female cattle that have a phenotypic average above the population average (Warmadewi *et al*., 2017) [12]. Furthermore, the selected animals are allowed to reproduce with the hope that the genetic quality of their offspring will increase. The Government of Indonesia through the Indonesian Ministry of Agriculture has established a Bali cattle breeding center on the island of Bali with the aim of improving the genetic quality of pure Bali cattle on the island of Bali by conducting a continuous selection program. This effort must be supported by all parties, including livestock farming communities that maintain Bali cattle (Kusuma *et al*., 2019) [6]. Badung Regency as one of the regencies on the island of Bali formed the "People Husbandry Business Center (SPR)" under the name "SPR Jaya Giri" located in Badung Regency, Bali Province. People's Animal Husbandry Centers or several livestock groups that join in one of the businesses, one of which is to increase the income of farmers, so that farmers are more excited to keep Bali cattle (Putri *et al*., 2017) [17].

Various efforts are expected to be carried out in this SPR, one of which is implementing a selection program to improve the genetic quality of Bali cattle (Warmadewi *et al*., 2019) [13]. The selection program will be effective if the population of animals to be selected has a characteristic with high phenotypic diversity.

For the effectiveness of selection, several variables of high economic value such as body dimensions can be measured and their diversity calculated. This diversity determines the selection process to be carried out. If the phenotypic diversity is high, then within breed selection will be effective and efficient. Conversely, if the phenotypic diversity is low, it needs to be taken into account to bring cattle from outside the population, so that the phenotypic diversity of the population increases. The magnitude of the phenotypic diversity of a population can be measured by calculating the coefficient of diversity. The purpose of this study was to determine the phenotypic diversity of the body dimensions of Bali cattle, in the Regency, Badung, Bali Province, Indonesia.

Materials and Methods

The research was carried out at the "Jaya Giri People's Farm Group (SPR) Center", located in Petang District, Badung Regency, Bali Province, Indonesia for 5 months. This study used 412 heads of male and female Bali cattle. The tools used in this study were fixation cages, measuring sticks, and measuring tapes.

The study was conducted by survey method, namely by direct measurement of body dimensions (chest girth, body length, and height of gumba) Bali cattle. The independent variable used in this study was the age of livestock based on the replacement of deciduous teeth with permanent teeth. Dependent variables were chest girth, body length, and gumba height. The control variable was livestock rearing management (the feed given is assumed to be the same).

Furthermore, the body dimension data (chest girth, body length, and height of the gumba) were grouped according to age group (teeth 0; 1; 2; 3; and 4) and gender. Then done the calculation of the phenotypic diversity of each variable. Measurement of body dimensions of Bali heifers (left) and Bali bull (right) (Fig.1)

Fig 1: Measurement of body dimensions of Bali heifers (left) and Bali bull (right)

From the calculation results we will get the coefficient of variation in the dimensions of the cattle's body at each age. If the coefficient of variation was greater than 15%, it can be concluded that the observed characteristics were stated to be varied (varied) and effective selection was carried out to improve the genetic quality of Bali cattle. Conversely, if the coefficient of variation <15%, then the selection will not be effectively carried out, it was necessary to consider bringing new cattle outside the existing livestock population in the "Jaya Giri People's Livestock Center (SPR) at Petang District, Badung Regency, Bali Province, Indonesia so that its diversity increases.

Analysis of phenotypic diversity of body dimensions (chest girth, body length, gumba height, and pelvic bone width) of Bali cattle in the "People's of Animal Husbandry Center (SPR) Jaya Giri" in Petang District, Badung Regency, Bali Province was carried out descriptively using the formula Coefficient of diversity (Coefficient of variation) = SD/X x 100% (Lasley, 1978) [7]. Note: SD = standard deviation of the population mean and X = population mean.

Results and Discussion

Table 1, shows the average and coefficient of diversity of body dimensions of female Bali cattle at different ages in "SPR Jaya Giri", Badung Regency, Bali Province, Indonesia. Based on Table 1, it can be said that the population of female Bali cattle contained in the "Jaya Giri SPR", in Badung Regency, Bali is homogeneous or uniform, because the coefficient values of body dimensions (chest girth, body length, gumba height and pelvic bone width) of cattle bali females are under 15%. This is consistent with the statement of Hanafiah (1991) [4] which states that the population is said to be uniform or homogeneous if the coefficient of phenotypic diversity is below 15%. On the contrary, it is said to be diverse if the coefficient of phenotypic diversity is above 15%.

Table 1: Average and Variation Coefficient of Body Dimensions of Female Bali Cows at Different Ages at "SPR Jaya Giri", in Badung Regency, Bali Province, Indonesia

Body dimensions	Age														
	I0			I1			I2			I3			I4		
	n	X	CV	n	X	CV	n	X	CV	n	X	CV	n	X	CV
Chest girth	94	134.65 ±13.92	10.34	81	147.44 ±6.36	4.31	38	153.29 ±10.70	6.98	27	158.56 ±11.33	7.14	87	161.61 ±8.53	5.28
Body length	94	101.21 ±10.47	10.35	81	111.15 ±6.56	5.90	38	112.87 ±7.37	6.53	27	118.81 ±8.37	7.04	87	120.03 ±14.18	11.82
Gumba height	94	101.71 ±8.89	8.74	81	109.43 ±4.92	4.50	38	108.71 ±5.61	5.16	27	108.96 ±5.06	4.65	87	111.41 ±4.96	4.45

Note:
n = The number of population
X = population mean
CV = Coefision of variation

When compared between ages/teeth, the coefficient of diversity of body dimensions (chest girth, body length, gumba height and pelvic bone width) in age-old female bali cows/I0 teeth on the "Jaya Giri SPR" in Badung Regency, Bali was higher compared to coefficient of diversity of body dimensions (chest girth, body length, gumba height, and pelvic bone width) aged bali cattle/teeth I1, I2, I3, and I4. This was possible, because of the mutation of age livestock/teeth I0, especially cattle that are off weaning to "SPR Jaya Giri". There were as many as 14 livestock groups in the "SPR Jaya Giri", all of which were breeding herds that raise bali cattle as prospective dam and dams. The government assistance given to the breeders group was mostly aged bali cows/teeth I0. Besides that, breeders also prefer to buy and maintain female Bali cattle compared to male Bali cattle.

Table 2: Mean and variation coefficient of body dimensions of male Bali cattle at different ages at "SPR Jaya Giri, at Badung Regency, Bali Province, Indonesia

Body dimensions	Age														
	I0			I1			I2			I3			I4		
	n	X	CV	n	X	CV	n	X	CV	n	X	CV	n	X	CV
Chest girth	33	133.73 ±17.18	12.85	17	162.88 ±14.64	8.99	11	163.09 ±8.02	4.92	8	181.88±12.54	6.90	16	174.06 ±14.55	8.36
Body length	33	98.64 ±13.41	13.59	17	115.06 ±11.37	9.88	11	122.00 ±6.08	4.99	8	129.88±9.58	7.38	16	127.50 ±6.21	4.87
Gumba height	33	99.67 ±8.05	8.08	17	111.94 ±6.77	6.05	11	116.27 ±5.73	4.93	8	125.00±5.07	4.06	16	121.38 ±7.28	6.00

Note:
n = The number of population;
X = population mean;
CV = Coefision of variation

The coefficient of diversity in height (gumba) of female Bali cattle at age/tooth I0 is the lowest compared to the coefficient of diversity in chest circumference, body length and pelvic bone width at the same age/teeth (I0). This is likely due to the provision of heifers in "SPR Jaya Giri" which require a certain height (gumba). The average height (gumba) of female Bali cattle at age/teeth I0 was 101.71 cm (Table 1). The height of the cow is in accordance with the conditions set by the government.

Table 2, shows the coefficient of diversity of body dimensions (chest circumference, body length and height of gumba) male Bali cattle at different ages/teeth (I0, I1, I2, I3 and I4). The coefficient of diversity in chest circumference, body length, gumba height and pelvic bone width) at age/teeth I0 was 12.85%; 13.59%; and 8.08%. At age/tooth I1 each was 8.99%; 9.88%; and 6.05%. At age/tooth I2 each was 4.92%; 4.99%; and 4.93%. At age/tooth I3 each was 6.90%; 7.38%; and 4.06%, while in the age/tooth I4 respectively: 8.36%; 4.87% and 6.00%. Based on the results obtained it can be said that the population of male Bali cattle in "SPR Jaya Giri", in Badung Regency is uniform or homogeneous.

The coefficient of diversity of body dimensions (chest girth, body length and height of gumba) male Bali cattle at age/teeth I0 is higher than the coefficient of diversity of body dimensions (chest circumference, body length and gumba height) male Bali cattle at age/tooth I1; I2; I3; and I4. Similar to female Bali cows, this is likely caused by the mutation of age/tooth teeth I0, especially those that are weaned to the "SPR Jaya Giri". However, mutation of male Bali cattle is probably lower than female Bali cattle of the same age/teeth. This is evident from the lower population of male Bali cattle compared to female population of Bali cattle. This is probably due to the interest of breeders who tend to prefer keeping female Bali cows compared to male Bali cattle. Besides that, the government assistance to livestock groups in "SPR Jaya Giri" is mostly female Bali cows.

Overall it can be said that the population of Bali cattle in the "SPR Jaya Giri", in Badung Regency is uniform or homogeneous. This can be seen from the coefficient of diversity in body dimensions (chest girth, body length and height of gumba) which is less than 15% at all age/tooth levels. The same results were also obtained in the male Bali cattle population, where the coefficient of diversity of body dimensions (chest girth, body length and height of gumba) was also lower than 15% at all age/tooth levels.

Based on the results of this study it can be concluded that selection based on body dimensions (chest girth, body length, gumba height and pelvic bone width) in female cows and selection based on body dimensions (chest girth, body length and gumba height) in male Bali cattle at various levels age/teeth (I0; I1; I2; I3; and I4) are less effective in the "SPR Jaya Giri", in Badung Regency, Bali. The aim of the selection program is to improve the genetic quality of livestock in that population. Efforts that can be made so that an effective selection program is implemented in this population is to bring cattle from outside this population. The aim is to increase the phenotypic diversity, so that selection will be effectively carried out. This is consistent with the opinion of Lasley (1978) [7] and Noor (2010) [8] which states that if the phenotypic diversity is high, then selection within breeds will be effective and efficient. Conversely, if the phenotypic diversity is low, it needs to be taken into account to bring cattle from outside the population, so that the phenotypic diversity of the population increases.

Conclusion

Based on the description above, we can conclude that the diversity of Bali cattle population in Badung Regency, Bali Province, Indonesia was included in uniform or homogeneous categories. To increase population diversity, it can be done by bringing new livestock populations to the "SPR Jaya Giri", at Badung Regency, Bali Province, so that the selection program is effective.

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