HERITABILITY ESTIMATE AND GENETIC RESPONSE TO SELECTION FOR YEARLING WEIGHT IN BALI CATTLE

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ABSTRACT

This study was carried out at Bali Cattle Breeding Centre (*BPTU Sapi Bali*) in Pulukan, Jembrana, Bali from March to November 2012. The aims of study were to estimate the heritability and genetic response to selection for yearling weight in Bali cattle. Records on 350 yearling weights of Bali cattle born from 2007 to 2011 at the Bali Cattle Breeding Centre were used in this study.

The results showed that the average coefficient of variation for yearling weight of Bali cattle was 18.28%, the estimated heritability (h^2) was 0.42 ± 0.19, and the selection intensity was 0.92. This value indicated that selection for this trait might improve the genetic quality of Bali cattle particularly in their liveweight at one year old. Estimation of genetic response (Rg) obtained in this study was 9.02 kg. The average generation interval in this population was 4.48 years. Therefore, response per year (Ry) for yearling weight in this breed of cattle was 2.01 kg. Based on this response per year, prediction for response in the year 2010 and 2011 were 6.03 kg and 12.06 kg respectively. It was concluded that the heritability estimate of yearling weight in Bali cattle was categorized high and selection for this trait responded effectivelly

Key Word: Bali cattle, coefficient of variation, heritability, generation interval, selection intensity, genetic response

INTRODUCTION

Bali cattle (*Bos sondaicus*) are the best Indonesian local cattle breed originated from Bali island of Indonesia. As meat animals, Bali cattle have several good traits, such as high fertility (Oka and Darmadja, 1996), and reproductive efficiency (Gunawan and Ronjali, 2010), able to withstand in new environment, especially in low quality feed (Sastradipraja,1990), high carcass percentage (Payne and Rollison, 1973), high meat quality (Payne and Hodges,

1997) and resistance to ticks (*Boophilus sp*) and worms (Wijono and Mas'um, 1981) .

However, it seemed that performance of this breed of cattle decreased from several years ago particularly on their body weight. Oka (2009) stated that performance of Bali cattle was not like in the pass since it was difficult to find Bali cattle heavier than 500 kg live weight at present. If this condition is left for long time, Bali cattle may not be classified as the best local cattle in Indonesia in the future, because of their superiority have been lost. Therefore, efforts to improve their performance must be required. It has been known that animal performance including production and their product quality are depended on the genetic potential of the animals and their environment. Consequently, improvement of the genetic potential of Bali cattle is needed besides the availability of feed as the highest part of the environment.

Selection and good breeding practice are two main actions that should be done to improve the genetic potential of Bali cattle which are thought might be decreased. The effectiveness of selection depends on the phenotipic variation and heritability of the selected trait, selection intensity, and generation interval of the population. This research was carried out at Bali Cattle Breeding Centre (*BPTU Sapi Bali*) to find out the average live weight of Bali cattle at one year old and its coefficient of variation, heritability estimate, selection intensity, generation interval of the population, and estimation of genetic improvement of yearling weight from 2008 up to 2011.

MATERIALS AND METHOD

The studi was carried out at the Bali Cattle Breeding Centre (*BPTU Sapi Bali*) in Pulukan, Jembrana, Bali. Records of yearling weight on 350 Bali cattle born from 2007 to 2011 at this Breeding Centre were used in this study.

Live weight around one year old of 350 calves were measured and adjusted to 365 days old, phenotypic coefficient of variation of the yearling

weight was calculated, its heritability (h^2) was estimated, the average selection intensity, generation interval were calculated, and genetic response (Rg) of yearling weight was estimated.

The coefficient of variation (CV) was calculated by using formula CV= SD/X x 100% where SD is phenotipic standard deviation and X is the average of yearling weight (Lasley, 1978), heritability (h^2) was calculated by one-way analysis of variance (Becker, 1985) with the formula : $h^2 = 4\delta^2_s/(\delta^2_s+\delta^2_w)$. Value of selection intensity (i) was calculated base on the portion of animals retained for breeding in the population. Generation interval (Ig) was calculated by the average age of parents when their offspring was born (Falconer and Mackay,1996 and Noor (2010). Genetic response per generation (Rg) was calculated by the formula : $Rg = h^2 \times i \times SD$. Genetic response per year (Ry) was calculated by using formula Ry = Rg/Ig and the response to n years was calculated by the formula Rn = 1/2n (n + 1)Ry (Lasley, 1978). The data was processed using SPSS 16.0.

RESULTS AND DISCUSSION

The average live weight of Bali cattle at one year old in this study was 127.70±23.34 kg and its coefficient of variation was 18.28%. These showed that the population were heterogen in their yearling weight since their coefficient of variation above 15%. This meant that selection based on this live weight was relatively effective. Selection for yearling weight in this Breeding Centre was started in the year 2008 when the progeny of the population in the year 2007 reached the age of one year old in 2008. The average selection intensity in this population was 0.92 based on the average fraction of animals kept for breeding in the year 2008 up to 2010. The heritability estimate of yearling weight in this Bali cattle population was 0.42±0.19 while the average generation interval was 4.48 years (Table 1).

Table 1. Phenotypic and Genetic Parameters, and Genetic Response of Yearling Weight in Bali Cattle

Parameters	Values
Average yearling weight (kg)	127.70±23.34
Phenotypic coefficient of variation (%)	18.28
Heritability of yearling weight	0.42±0.19
Selection intensity	0.92
Genetic response/Rg (kg)	9.02
Generation interval/Ig (year)	4.48
Genetic response per year/Ry (kg)	2.01

Based on the above results, it might be estimated the genetic response to selection for yearling weight in this Bali Cattle Breeding Centre. The genetic response which was calculated using the formula Rg= h^2 x i x SD resulted Rg= 0.42 x 0.92 x 23.34 = 9.02 kg. Since the average generation interval was 4.48 years (Table 1) therefore response per year (Ry) would be Rg/Ig= 9.02/4.48 = 2.01 kg.

The genetic improvement of Bali cattle in the following years after selection program was carried out in this population might be predicted using the formula: Rn= 1/2n(n+1)Ry. Therefore the genetic improvement of Bali cattle yearling weight in the year 2009 was ½.1(1+1)Ry= 2.01 kg, in the year 2010 was ½.2(2+1)Ry= 6.03 kg, and in the year 2011 was ½.3(3+1)Ry= 12.06 kg. Since the average yearling weight of Bali cattle in the year 2008 was 124.11 kg. The genetic potential of this cattle population in the year 2009, 2010, and 2011 for live weight at one year old would be 126.12, 130.14, and 136.17 kg respectively. Based on the above estimation, the yearling weight of Bali cattle in *BPTU Sapi Bali* was effectively used as a selection criteria to improve the genetic potential at this location. This is agree with the statement of Warwick *et al*. (1995) which stated that the value of heritability which were classified as moderate to high indicated that the selection for this trait will be more effective and efficient to improve the genetic quality of livestock when compared to the low heritability.

The high heritability of yearling weight in this breed of cattle suggested that genetic factors play an important role in determining its phenotypic variation. Yearling weight was determined by the animals own genetic factors which were

obtained from their parents and influenced by the environmental factors where the animals were kept. In this case, variation of yearling weight in this population was affected by genetic factors and 58 % was influenced by environmental factors. This condition might explain that the high heritability of yearling weight in this population was due to the genetic advantages from the selected parents. Heritability of yearling weight in this study was higher than the result reported by Karnaen (2013) and Supriyantono *et al*. (2012) who found the heritability estimate of yearling weight of Bali cattle 0.27, but it is similar to the result reported by Sumadi (2009) who obtained the heritability of yearling weight was 0.47 ± 0.17 in PO cattle.

The generation interval (Ig) of Bali cattle in *BPTU Sapi Bali* from 2008 up to 2011 was 4.48 years. This generation interval was shorter than reported by Noor (2010). It can be catagorized short since its value was less than 6 years, where generation interval in cattle was 6-7 years. The length of the generation interval varies with different breeding and management systems followed to produce a new generation of breeding animals (Hardjosubroto, 1994). Bourdon (1997) suggested that there was correlation between the generation interval and selection intensity. The high selection intensity means there are many cattle maintained for breeding in the population and consequently the generation interval will be longer. Generation interval is used to calculate the genetic response per year. Genetic response per year is the genetic response per generation devided by generation interval. The longer the generation interval, the smaller the selection progress might be achieved. The older the parent were kept for breeding the longer the generation interval will be and consequently the genetic response per year will be smaller.

The impact of selection for yearling weight in Bali cattle at Bali Cattle Breeding Centre (*BPTU Sapi Bali*) is presented in Figure 1. Improvement of the genetic potential in the year 2009 up to 2011 did not follow by the real performance (yearling weight) if Bali cattle in this breeding program. The availability of feed particularly grass and other rouhage such as legum were varies and not enough for the cattle along the whole years. Supplementation of

concentrate which was inconsistent particularly during dry season did not support the maximum growth of the calves.

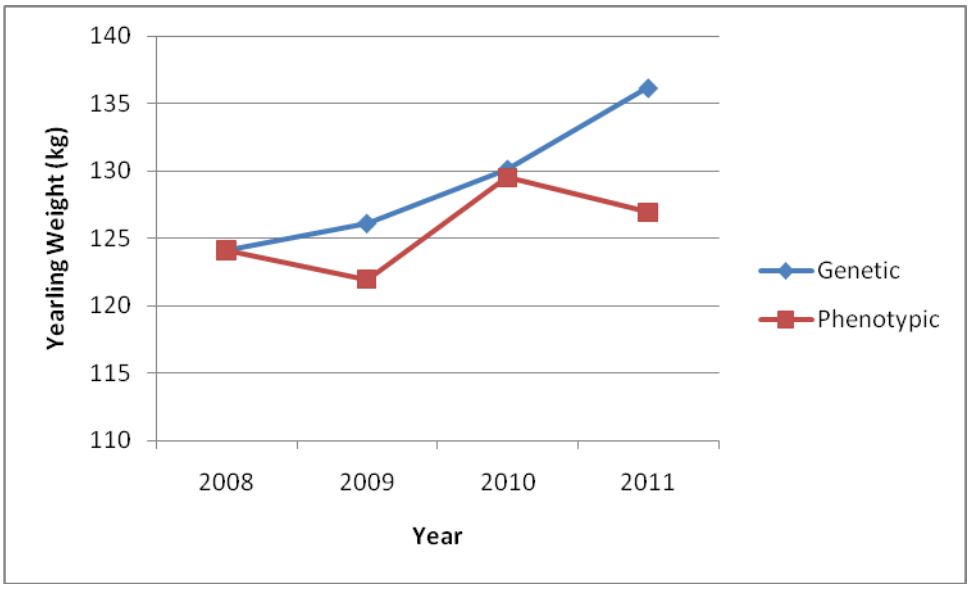

Figure 1. Response to Selection for Yearling Weight in Bali Cattle

According to Warwick *et al*. (1995) and Lasley (1978), there are two factors that affect the performance of cattle ie: genetic and environment. Feed is one of the most environmental factors affecting the performance of yearling weight. The genetic expression wil be maximum if supported by an optimal environment.

CONCLUSION

Based on the above results, it can be concluded that the coefficient of variation and heritability estimate for yearling weight in Bali cattle at Bali Cattle Breeding Centre (*BPTU Sapi Bali*) were categorized high and selection for yearling weight in this cattle breed improved their genetic potential. It seemed that the lower performance of yearling weight compared to their genetic potential in this breeding centre mainly because of the lack of feed as the most important factor to support the growth of the calves.

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