Breed and age of dams effects on calving and weaning rates of Brakmas and Bali cows

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Received: 3 April 2017. Accepted: 29 May 2017.

Abstract

Evaluation of animals reproductive capacity is very important to the animal breeders as it will be the turning point of gaining profit or loss in livestock enterprises. The objective of this study was to evaluate the breed and age of dam effects on the reproductive performance, namely calving and weaning rates of Brakmas and Bali cattle. This study involved a total of 384 Brakmas cows raised in MARDI Muadzam Shah with the age ranging from 3 to 15 y, and 85 Bali cows with an age range of 5 to 11 y originally obtained from Gorontalo, Indonesia. Purebreeding was carried out from 2008 to 2012 where the animals were divided into groups with bull to cow ratio at 1:25 and allowed to graze freely on *Brachiaria decumbens* pasture. The study showed that breed affected significantly ($P<0.05$) on calving and weaning rates where Brakmas cattle were superior than Bali cattle for calving rate, 0.88±0.02 and 0.78±0.08, respectively, while Bali cattle recorded higher weaning rate compared to Brakmas cattle, 0.63±0.11 and 0.58±0.03, respectively. Age of dam and production year also showed significant effects ($P<0.05$) on the reproductive traits studied. It is concluded that apart from the breeds themselves, production years also plays an important role in determining calving success and calf-crop weaned percentage as the breeds respond differently towards the environmental changes.

Introduction

In beef production, the output from cows is important as it reflects the maternal productivity. Maternal productivity also considers inputs, as it is a composite trait that is influenced by fertility, survival and mature size (Mwansa *et al.*, 2002). Birth and weaning weights are the examples of traits that are affected by maternal effects (Dodenhoff *et al.*, 1998). Good maternal ability is very important in many species for the survival and growth of the offspring. The importance of good maternal behavior is emphasized by Cunningham and Henderson (1965) as the pre-weaning performance of calves is the factor that will determine the economic return in beef production. The ongoing selection for production, such as the increased growth and reproduction, will be demanding to the dams during the pre-weaning period (Grandinson, 2005).

Calf survival has a major influence on the profitability of beef cattle production (Phocas *et al.*, 1998), while in dairy enterprise, besides the production potential of animals, their survival rate is also important as the replacement stock available determines the number of animals that can be culled for poor production (Rao and Nagarcenkar,

1980). Meijering *et al.* (1993) stated that high mortality of calves reduces income and adds significantly to beef production costs.

Calving rate is defined as the ratio of the total number of calves born over the number of cows exposed to breeding. Cows that calved were given the value of one, while cows that failed to calve were assigned the value of zero, regardless of the cows found pregnant or not during rectal palpation. Calf-crop weaned percentage is based on number of calves weaned per number of cows exposed to breeding. A cow that weaned a calf was assigned value of one, while a cow that failed to wean a calf was assigned the value of zero. Pre-weaning viability is the number of calves survived at weaning at the age of 6 mo, where calves that survived until weaning were assigned value of one while calves that died within 6 mo were assigned value of zero (Riley *et al.*, 2001).

Brakmas cattle is a composite breed developed from the crossbreeding between Brahman and local Kedah-Kelantan cattle and has the potential to be commercially propagated to be integrated in the oil palm plantations (Johari and Jasmi, 2009), while Bali cattle were imported from Indonesia as an alternative breed for farmers due to its high fertility rate, high production performance, highly adaptable to local environment, high dressing percentage, high resistance to parasites, rapid recovery after poor usage, and good work capability (Chamdi, 2005). Therefore, the objective of this study was to evaluate the effect of breeds and age of dams on calving and weaning rates of Brakmas and Bali cows in MARDI Muadzam Shah, Pahang.

Materials and Methods

Purebred mating was used for the breeding of Brakmas and Bali cattle. Brakmas cattle used in this study were born and raised in MARDI Muadzam Shah, while Bali cows were obtained from Gorontalo Province, Indonesia in 2009. The animals were mated at 1:25 bull to cow ratio. A total of 384 Brakmas cows with the age ranging from 3 to 15 y and 85 Bali cows with an age range from 5 to 11 y. Records on reproductive performance, namely calving success and calf weaned, were collated from 2008 to 2012 and used in this study. For the least square analysis, only dams aged 5 to 11 y old were included in the analysis as they were represented in both breeds.

The animals were in the average body condition score of 3 out of 5 (5=animals being in excess of fat cover; 3=in moderate fat cover; 1=emaciated, based on Ariff et al., 2010) and free from Brucellosis and Foot and Mouth Disease. Breeding soundness evaluation was conducted of the bulls prior to mating. Only bulls with good vision, moderate body condition score, free from contagious diseases such as Brucellosis and Foot and Mouth Disease, and had passed semen quality evaluation were used in this study.

Animals were controlled and separated using barbed-wire fencing and allowed to graze on *Brachiaria decumbens* pasture. Supplementary feed in the form of palm kernel cake pellet were given at 1% of body weight on dry matter basis for 2 wk prior to breeding. Animals were mated for 60-d breeding period and rectal palpation was conducted 60 d after the removal of bulls. New-born calves were given identification number (ear tag and tattoo numbers) and weighed within 24 h. Other information such as sex of calf, dam and sire identification, birth date and body measurements were recorded. Calves were weaned at 6 mo of age.

The model used to analyze the calving and weaning rates is presented below:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \infty_k + e_{ijk}$$

where

Y_{ijk} = the observed value for the ijk^{th} cow for the trait measured,
μ = the overall mean for the trait,
α_i = the fixed effect of i^{th} breed,
β_j = the fixed effect of the j^{th} production year,
∞_k = the fixed effect of the k^{th} age of dams,
e_{ijk} = the random error associated with the ijk^{th} observation

Statistical analysis

Data for reproductive performance included calving rate, pre-weaning viability and calf-crop weaned and they were evaluated as binary traits (Riley *et al.*, 2001). Data were analyzed using least square analysis and Duncan Multiple Range Test for mean comparison for the effects of breed, year of production and age of dam using SAS 9.1.

Results and Discussion

Analysis of variance for calving and weaning rates

Analysis of variance for calving and weaning rate of Brakmas and Bali cattle is presented in Table 1. Breed, age of dam and year of calving showed significant effect ($P<0.05$) on calving rate of these cattle. The significant differences in calving rate between breeds were also found in Angus, Brahman, Charolais and Hereford (DeRouen and Franke, 1989), Brahman, Charolais, Angus and Hereford (Williams *et al.*, 1990), Angus-Hereford, Gray Brahman-Hereford, Gir-Hereford, Indu Brazil-Hereford, Nellore-Hereford and Red Brahman-Hereford (Riley *et al.*, 2001), Brahman-Angus, Senepol-Angus and Tuli-Angus crosses (Chase *et al.*, 2004) and Hereford-Brangus and Bonsmara-Angus crosses (Wyatt *et al.*, 2014). However, Comerford *et al.* (1987) found that there was no significant difference among Simmental, Limousin, Polled Hereford and Brahman cattle, which also agreed with the finding of Peacock and Koger (1980). Significant effect of age of dam on calving rate was also found in Angus, Brahman, Charolais and crossbred dams (Peacock and Koger, 1980) and Hereford, Angus and Shorthorn cattle (Núñez-Dominguez *et al.* 1991).

Weaning rate is defined as total number of weaned calves divided by total number of cows exposed to bulls for breeding. The analysis of variance results for weaning rate are shown in Table 2. The results indicated breed, age of dam and year of calving had affected significantly the weaning rate ($P<.0001$). The effect of breeds towards weaning rate was also found to be significant by Williams *et al.* (1990) where Angus, Charolais and Hereford cattle showed superiorities over Brahman cattle on percentage of calf-crop weaned. Comerford *et al.* (1987) also found significant dam breed effect where Limousin cattle weaned significantly higher than Simmental and Hereford cattle, but not significant when compared to Brahman cattle, while the same study also reported a significant finding of year effect towards calves weaned/cows exposed to breeding. Chase *et al.* (2004) found a significant effect of breeds and years towards weaning rate where the average calf-crop weaned of Senepol-Angus was lower than Brahman- and Tuli-Angus crossbred. A study by Peacock and Koger (1980) also showed a similar result where age of dam and years affecting the weaning rate of Angus, Brahman, Charolais and crossbred dams. Riley et al. (2001) found a significant effect of breeds where weaning rate of Angus-Hereford was lower than Nellore-Hereford. Frisch *et al.* (1987) suggested that year effect played a significant role in determining the weaning rate. Each different year gave different environmental stress such

as the minimum and maximum temperature that contributed to high or low heat stress, rainfall that led to the availability of forages, and humidity. The same study showed that the Hereford-Shorthorn line had a higher calf crop compared to Brahman line in a year that had low environmental stress; however there was a reversal trend in the year with high environmental stress. The interaction between breed and year effects offers a similar explanation as each breed differs in fertility potential, which can thus be concluded from the difference between the high and low calf crops. In other words, each breed responds differently to the environmental changes.

Table 1. Analysis of variance for calving and weaning rates of Brakmas and Bali cattle

Parameters	Source	df	P value
Calving rate	Breed	1	0.0002
	Age of dam	6	<.0001
	Year of calving	4	<.0001
Weaning rate	Breed	1	0.0079
	Age of dam	6	0.0001
	Year of weaning	4	<0.0001

Least square analysis for calving rate of Brakmas and Bali Cattle

Least square mean analysis results for calving rate of Brakmas and Bali cattle are presented in Table 2. Brakmas cattle showed higher (P<0.05) calving rate compared with Bali cattle with the calving rate of 0.88±0.02 and 0.78±0.08, respectively. The calving rate of Brakmas cattle was lower than the Brahman-KK and Kedah-Kelantan as reported by Johari *et al.* (1994) with calving rate of 95.4% and 92.4%, respectively. Nine-year old Brakmas cows recorded the highest calving rate of 0.91±0.01 while eight-year old cows the lowest with 0.79±0.06. It was a similar finding with the Bali cows where the highest and the lowest calving rate did not show any significant difference (P>0.05). Significant differences were found in the analysis based on age groups where the calving rate of 8-y old cows were lower than 10- and 11-y old cows (P<0.05). Other age groups that showed significant differences were between 5- vs 6-y old cows (P<0.05).

Eleven-year old Bali cattle recorded the highest calving rate of 0.95±0.03 while 9-y old Bali cattle showed the lowest calving rate of 0.29±0.21. The analysis also showed that the calving rate for 6- vs 9-y old Bali cattle were significantly different (P<0.05). However, the highest and the lowest calving rate did not significantly differ (P>0.05), which might be due to small sample size. This study also found that the calving rate of Bali cattle raised in MARDI Muadzam Shah was comparable to those reported by Martojo (2012) where the calving rate of Bali cattle in Bali, Nusa Tenggara Timur, Nusa Tenggara Barat and South Sulawesi were 66.3%, 66.6%, 51.7% and 60.4%, respectively. However, an earlier study done by Pane (1990) in the same region of Indonesia reported higher calving rates.

The comparison of Bali and Brakmas cattle at the same age groups indicated that Brakmas cattle were superior than Bali cattle in terms of calving rate for each age group except for the 11-y old cow group where Bali cattle had a higher calving

rate. Significant differences (P<0.05) were found in the 7-, 8-, 9- and 10-y old cow age groups where Brakmas cattle recorded higher calving rate compared to Bali cattle. Bali cattle showed higher calving rate at the age of 11 y, however no significant difference was found (P>0.05).

Table 2. Least squares means and standard error (SE) for calving rate of Brakmas and Bali cattle

	Breed	
	Brakmas	Bali
Overall mean	0.88±0.02*	0.78±0.08
Age of dam		
5	0.90±0.05^{ad}	0.52±0.03^{ab}
6	0.91±0.04^{b}	0.88±0.07^{a}
7*	0.82±0.04^{abc}	0.76±0.05^{ab}
8*	0.79±0.06^{ad}	0.44±0.23^{ab}
9*	0.91±0.01^{ab}	0.29±0.21^{b}
10*	0.90±0.07^{bc}	0.48±0.21^{ab}
11	0.90±0.05^{bc}	0.95±0.03^{ab}

^{abcd} Least squares means within a column without common letter superscripts are different (p<0.05)

* Significant at p<0.05 within a row

Year of calving was found to be significant (P<0.001) for calving rate of Brakmas and Bali cattle. This finding was similar to that of Comerford *et al.* (1987). Brakmas cattle showed the highest calving rate in 2009 with the calving rate of 0.97±0.02, while the lowest was in 2011 with the calving rate of 0.68±0.02 (Table 4). The highest and lowest value of calving rate showed significant effect (P<0.05). For Bali cattle, the highest and the lowest calving rate were recorded in the year 2011 (0.87±0.03) and 2009 (0.15±0.10), respectively. The low calving rate of the Bali cows in 2009 was due to the environmental adjustment the animals underwent since their arrival from Gorontalo, Indonesia at the end of 2008, so that the animals needed to adapt to a new environment and management system. Another factor was the use of bulls that did not undergo breeding soundness evaluation as they were purchased from villagers in Indonesia. Bull factor seemed to be significant as another group of Bali bulls purchased from FELDA in 2010 were evaluated for breeding soundness. This was shown by the increase in calving rate in 2010 onwards. In the year 2009, Brakmas cattle showed higher calving rate compared to Bali cattle (P<0.05) where the calving rate of Brakmas and Bali cattle were 0.97±0.02 and 0.15±0.10, respectively. Again, the environmental factor played an important role as the Brakmas cattle were already born in the local environment while the imported Bali cattle needed time to adapt to a new environment and management system.

Table 3. Calving rate (± SE) of Brakmas and Bali cattle from 2008-2012.

Year	Brakmas	Bali
2008	0.96±0.03[a]	NA[1]
2009[*]	0.97±0.02[a]	0.15±0.10[a]
2010	0.74±0.13[b]	0.67±0.14[b]
2011	0.68±0.02[b]	0.87±0.03[b]
2012	0.77±0.05[b]	0.65±0.09[b]

[ab] Least squares means within a column without common superscripts letter are different (P<0.05)
[*] Significant at P<0.05 within a row
[1]NA not available

Least square analysis for weaning rate of Brakmas and Bali cattle

Least squares means for weaning rate is presented in Table 4. Bali cattle recorded higher value for overall weaning rate compared to Brakmas cattle, of 0.63±0.11 and 0.58±0.03, respectively. However, Brakmas cattle aged 9- and 10 y old showed higher weaning rate compared to Bali cattle. The only significant difference was found at 6-year old, where Bali showed higher weaning rate compared to Brakmas cattle (0.65±0.17 and 0.53±0.07, respectively).

Ten-year old Brakmas cows showed the highest weaning rate (0.76±0.08) while 7-y old cows showed the lowest (0.50±0.08) and significantly differed between these two age groups (P<0.05). Ten-year old Brakmas cows showed significant difference (P<0.05) in weaning rate with 5-, 6-, 7-, and 8-y old cows but not with 9-y old cows.

Five-year old Bali cattle recorded the highest weaning rate, while the lowest was recorded by 9-y old cows group with the calf-crop percentage of 0.71±0.23 and 0.50±0.21, respectively. This high and low value of percentage of calf-crop weaned was found to be significantly different (P<0.05). Apart from the above mentioned significant relationship, no other significant difference between ages was found in Bali cattle.

Table 4. Least squares means and standard error (SE) for weaning rate of Brakmas and Bali cattle

	Breed	
	Brakmas	Bali
Weaning rate	0.58±0.03[*]	0.63±0.11
Age of dam		
5	0.55±0.07[a,c]	0.71±0.23[a]
6[*]	0.53±0.07[a,c]	0.65±0.17[ab]
7	0.50±0.08[a,c]	0.63±0.16[ab]
8	0.59±0.10[a,c]	0.60±0.36[ab]
9	0.54±0.13[b,c]	0.50±0.21[b]
10	0.76±0.08[b]	0.62±0.11[ab]
11	0.57±0.13[a,c]	0.67±0.27[ab]

[abc] Least squares means within a column without a common letter superscript are different (p<0.05)
[*] Within a row significant at p<0.05

Weaning rate or percentage of calf-crop weaned of Brakmas and Bali cattle from 2009 to 2013 is presented in Table 5. For Brakmas cattle, it was found that the highest and the lowest weaning rate was recorded in the year 2009 and 2012, respectively and was found to be significant (P<0.05). The highest weaning rate was 0.90±0.03 and the lowest was 0.63±0.06 for the year 2009 and 2012, respectively. The weaning rate for Brakmas cattle was found to be divided into two groups, that were Group A (2009 and 2010) and Group B (2011 and 2012) and Group A recorded higher weaning rate compared to Group B (P<0.05). Calf-crop weaned for the year 2013 was found to be not significant (P>0.05) either with the year in Group A or Group B.

Calf-crop weaned in 2010 was found to be the lowest (P<0.05) compared to 2011, 2012 and 2013 for Bali cattle as shown in Table 5. It was a similar result to the calving rate of Bali cattle as discussed earlier where the calving rate in 2010 was found to be the lowest compared to the year 2011 onwards. It is explained by the low number of calves born over the number of cows mated in 2009. The result also showed that the weaning rate over the years was clustered into two groups; where the year 2011, 2012 and 2013 belonged to one cluster while the weaning rate in 2010 was by itself. The highest weaning rate for Bali cattle was found in 2012 with the weaning rate of 0.75±0.09.

The weaning rate for Brakmas and Bali cattle was found to be significantly different for all production years (P<0.05). It was found that the weaning rate for Brakmas was higher than Bali cattle (P<0.05) in the year 2010, 2011 and 2013, while weaning rate of Bali cattle was higher in 2011 (P<0.05). The weaning rate of Brakmas versus Bali cattle were 0.90±0.02 vs 0.13±0.08, 0.69±0.05 vs 0.58±0.05 and 0.75±0.10 vs 0.55±0.13 for 2010, 2011 and 2013, respectively; while in 2012 Bali cattle recorded higher weaning rate (P<0.05) compared to Brakmas cattle at 0.75±0.09 and 0.63±0.06, respectively. Although Bali cattle recorded higher weaning rate in 2012, the total number of calves weaned in 2012 was less than Brakmas cattle where the number of calves weaned for Bali and Brakmas cattle in 2012 were 48 and 63, respectively. The higher weaning rate recorded by Bali cattle was due to the lesser number of cows mated compared to Brakmas cattle, where the number of cows mated for Bali and Brakmas cattle in 2012 were 64 and 100, respectively. The number of cows mated affected the higher calving rate of Bali cattle in 2012 even though the number of Brakmas calves born was higher than Bali cattle (68 vs 56 heads of calves born).

Table 5. Calf-crop weaned (±SE) of Brakmas and Bali cattle form 2008 to 2012

Year	Brakmas	Bali
2009	0.90±0.03[a]	NA[1]
2010*	0.90±0.02[a]	0.13±0.08[a]
2011*	0.69±0.05[b]	0.58±0.05[b]
2012*	0.63±0.06[b]	0.75±0.09[b]
2013*	0.75±0.10[ab]	0.55±0.13[b]

[ab] Least squares means within a column without common letter superscripts are different (p<0.05)

* Significant at p<0.05 within a row

[1]NA not available

Conclusion

Brakmas cattle were superior at calving rate, while Bali cattle showed better performance in weaning rate. However, apart from the breed itself, environmental factors also played a significant role in determining the maternal performance as the Bali cattle needed time to adapt to new environment and management system when they first arrived at the farm.

Acknowledgement

The author would like to thank the staff of MARDI Muadzam Shah Beef Cattle Breeding Unit for the assistance in the recording, compilation and management of the animal information and reproductive data during the duration of the study.

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