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Investigating reasons for lower birth weight in crossbred calves

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ABSTRACT

The present study was carried out to investigate the reasons of lower birth weight in crossbred (50–75% Exotic and 25–50% Hariana) calves. The data on birth weight of 2,102 crossbred calves, progeny of 22 sires over a period of 11 years from 2005 to 2015 were analyzed under investigation using Least Squares analysis. Heritability of birth weight was calculated using half sib correlation method. The observed parameters were period of calving, season of calving, sex of calf, parity of dam, age of dam at calving, weight of dam at calving and sire of calf. Research results revealed that average birth weight of crossbred calves was 21.92 kg. The effect of period of calving, season of calving, sex of calf, age of dam at calving, weight of dam at calving and sire of calf was statistically significant on birth weight. Birth weight showed increasing trend across the periods. The heaviest (9.47% more than rainy) birth weight was observed for calves, born in hot-dry (summer) season whilst, it was the lowest in those born in hot-humid (rainy) season. Male calves were heavier (3.66% more) at birth than the female calves. Cows more than 6 years of age and 400 kg body weight produced the heaviest calves. Five sires (22.72%) had their calves with more than 24 kg birth weight. Heritability of birth weight in crossbred calves was moderate (0.24±0.08) reflecting the ample scope of improvement through proper feeding and care of dam.

Key words: Birth weight, Crossbred cattle, Dam effect, Heritability, Season, Sex of calf, Sire

Crossbred cattle have a great say in making India self sufficient in milk production. India ranks topmost in milk production with a total production of 137.7 MT (BAHS 2015). The present crossbred cattle population of the country is 33 million, which is almost 17 % of total cattle population. These animals are however, facing a serious constraint of lower birth weight at many of the organized farms. Calves having optimum weight at birth have more survival rate during subsequent period. Both, very low as well as very high birth weight results in increased mortality and calving difficulties (Johanson and Burger 2003). The birth weight is one of the important economic traits having direct bearing on later growth, production and reproduction (Yaylak *et al.* 2015). It is also an important criterion in early selection for cattle breeding (Manoj *et al.* 2014). Numerous genetic and environmental factors like period and season of calving, sex of calf, sire, weight and age of dam influence birth weight of cattle (Olson *et al*. 2009, Raja *et al*. 2010). The present investigation was therefore undertaken to investigate the reasons of lower birth weight in crossbreds calves born over a period of 11 years.

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MATERIALS AND METHODS

The present investigation was undertaken at Cattle and Buffalo Farm, Livestock Production and Management Section, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh. The farm is located at an altitude of 169.2 m above the mean sea level, latitude of 28°22' North and longitude of 79°24' East. The place falls in upper Gangetic Plain region of India with humid subtropical climate having high variation (range from 4°C to 44°C) between summer and winter temperatures. The annual mean temperature is 25°C (77 °F). The average annual rainfall is approximately 1714 mm (28.1 inches), most of which (40–50%) occur during the monsoons in July and August months. The data on birth weight of 2,102 crossbred (50–75% Holstein Friesian+Jersey+Brown Swiss and 25–50% Hariana) calves, progeny of 22 sires over a period of 11 years from 2005 to 2015 were analyzed under the present investigation. Sire with more than 5 progenies were only considered. Birth weight of each calf was taken within twelve hours of birth.

Data were classified according to period of calving (2005–07, 2008–10, 20011–13, 2014–15), season of calving (March to June, hot dry; July to October, hot humid; November to February, winter), sex of calf (male, female), parity of dam (1 to 9), age of dam at calving (below 4 years, 4 to 6 years, 6 to 8 years, 8 to 10 years, 10 years and above), weight of dam at calving (below 300 kg, 300–350 kg, 350–400 kg, 400–450 kg, 450–500 kg, 500 and above) and sire

(1 to 22) . Data were subjected to Least Squares analysis using GLM (Generalized linear model) procedure of SAS 9.3 (SAS Inst. Inc., Cary, NC) incorporating period and season of calving; sex and sire of calf; and parity, age and body weight of dam in the model. Variance components of birth weight were estimated using Restricted Maximum Likelihood procedure through SAS 9.33 (SAS Inst. Inc., Cary, NC). Heritability of birth weight was calculated using half sib correlation method.

RESULTS AND DISCUSSION

The least squares means of birth weight in crossbred calves was 21.92±0.10 kg. It was slightly lower as compared to other crossbreds like *Frieswal* (26.93 kg) (Gaur *et al.* 2006, Kumar *et al.* 2008), *Karan-Fries* (27.3 kg) (Singh and Gurnani 2002), *Karan-Swiss* (28.03 kg) (Mandal and Sachdeva 1999) and *Sunandini* (28.4 kg) (Muhammed *et al*. 2015). The difference in birth weight in various crossbreds could be due to the genetic makeup of the herds and management practices adopted at different farms.

The least squares means according to period and season of calving are given in Table 1. Effect of period of calving was highly significant (P<0.01) on birth weight of calves. Later showed increasing trend across the period and it was the lowest in 2005–07 (22.31±0.42 kg) and highest in 2014–15 (23.92±0.50 kg). Our results corroborated the findings of earlier workers (Bakir *et al.* 2004, Kumar *et al.* 2008). Difference in performance across the periods reflected variation in environmental conditions (temperature and relative humidity), feeding, hygiene and dam management during gestation period (Manzi *et al.* 2012).

Season of calving had highly significant (P<0.01) effect on birth weight (Table 1). Average birth weight was the lowest in calves born in hot-humid (July to October, 21.32±0.15 kg) season followed by those born in winter (November to February, 22.29±0.15 kg) and hot-dry (March to June, 23.20±0.22 kg) season. Bakir *et al.* (2004) and Kuralkar *et al.* (2005) also observed significant influence of season of calving on birth weight. Singh and Guranani (2002) also reported the highest birth weight in spring born calves and the lowest in autumn born calves in Karan Fries cattle.

The least squares means according to parity of dam are presented in Table 2. The effect of age and weight of dam was statistically significant (P<0.01) on birth weight (Table 3). Birth weight showed increasing trend over the age of dam at calving. The lowest birth weight (21.56±0.42 kg) was recorded in cows of below 4 years, while it was the highest (23.70±0.53 Kg) in those of above 10 years. Birth weight, however did not differ significantly after 6–8 years of age (23.08±0.40 kg).

Similarly, birth weight showed increasing trend with increase in body weight of dam at calving. The lowest birth weight (22.13±0.45 kg) was noticed in cows of below 300 kg weight; while it was the highest (23.76±0.40 kg) in those having above 500 kg. Birth weight however did not differ significantly beyond 400 kg weight of dam (22.93±0.29 kg) at calving. These findings indicate that heavier cows allocate more nutrients during fetal growth resulting into heavier calves at birth and there is correlation between the dam's weight and calf birth weight (Bahashwan and Alfadli 2016). The results were in agreement with Paputungan and Makarechian (2000). Effect of parity was however non-significant on birth weight of calf. Kayastha *et al*. (2008)

Table 1. Least squares means for birth weight (kg) across the period and season of calving

Factor / Effect	Observations	Least squares mean (kg)	SEM
*Period of calving***			
2005–07	729	22.31	0.42
2008–10	568	22.40	0.36
2011–13	475	22.56	0.39
2014–15	330	23.92	0.50
*Season of caving***			
Hot dry	403	23.80^{a}	0.32
Winter	781	22.85^{b}	0.27
Hot humid	918	21.74^{c}	0.26

**Significant (P<0.01); Means bearing different superscripts column wise differ significantly.

Table 2. Least squares means for birth weight (kg) across parity of dam

Factor / Effect	Observations	Least squares mean (kg)	SEM
Parity of dam at calving			
1st	676	23.25	0.39
2nd	479	22.77	0.36
3rd	328	22.92	0.39
4th	232	23.00	0.41
5th	156	23.05	0.47
6th	106	21.98	0.53
7th	65	22.46	0.65
8th	31	23.09	0.88
9 or more	29	22.69	0.96

Table 3. Least squares means for birth weight (kg) across age and weight of dam

*Age of dam at calving***			
<4 year	886	21.56^{b}	0.42
4 to 6 year	575	22.29^{b}	0.38
6 to 8 year	358	23.08 ^{a}	0.40
8 to 10 year	182	23.37^{a}	0.45
>10 year	101	23.70^{a}	0.53
*Weight of dam at calving***			
<300 kg	126	22.13^{b}	0.45
300–350 kg	356	22.22^{b}	0.32
350–400 kg	587	22.35^{b}	0.28
400–450 kg	497	22.93^{ab}	0.29
450–500 kg	368	23.42^{a}	0.32
>500 kg	168	23.76^{a}	0.40

**Significant (P<0.01); Means bearing different superscripts column wise differ significantly.

Table 4. Least squares means for birth weight (kg) across sex and sire of calf

Factor / Effect	Observations	Least squares mean (kg)	SEM
*Sex of calf***			
Male	1079	23.21^{a}	0.26
Female	1023	22.39^{b}	0.26
*Sire of calf***			
1	5	20.87^{de}	1.97
2	13	21.06^{abcde}	1.29
3	230	21.50^{cde}	0.50
4	230	21.54^{cde}	0.50
5	125	21.64^{abcde}	0.51
6	5	21.80^{e}	2.00
7	196	21.83^{bcde}	0.43
8	63	21.91^{abcde}	0.70
9	166	22.01^{bcde}	0.44
10	54	22.47^{bcde}	0.69
11	102	22.49^{abcde}	0.52
12	54	22.87^{abcde}	0.68
13	104	22.96^{abcde}	0.49
14	11	23.19^{abcde}	1.36
15	27	23.41^{abcd}	0.90
16	97	23.84^{abcd}	0.55
17	145	23.97^{ab}	0.49
18	194	24.04^{ab}	0.47
19	133	24.11^{abc}	0.47
20	35	24.23^{abcd}	0.78
21	11	24.40^{abcd}	1.38
22	102	25.48^{a}	0.50

**Significant (P<0.01); Means bearing different superscripts column wise differ significantly.

also showed similar results in indigenous cattle of Asom.

The least squares means according to sex and sire of the calf are presented in Table 4. The effect of sex of the calf was statistically significant (P<0.01) on birth weight. The male calves (23.21±0.26 kg) were heavier than female calves (22.39±0.26 kg). Similar results were also observed by Olson *et al.* (2009) and Maltecca *et al.* (2006) in crossbred cattle. Kayastha *et al.* (2008) and Singh *et al.* (2011) also reported similar trend. Higher weight in male calves might be due to higher androgen hormone intensity of male fetus serum (Manzi *et al.* 2012). Sex ratio in present investigation (male:female) was 51:49, deviating in favour of males than the normal expectation of 50:50 ratio. Singh *et al.* (2004) also observed significant deviation from normal expectation in favour of male birth in Hariana and Jersey crossbred cows.

The sire effect was highly significant (P<0.01) on birth weight of calves (Table 4). The contribution of sires was found uneven in terms of progeny produced. Eleven sires produced 82.15% calves, whereas remaining 11 sires only contributed 17.85% progenies. Out of 22 sires under investigation, 8 (36.36 %) were below average (21.92±0.10 kg), whereas five (22.72%) had their calves with more than 24 kg birth weight. Top sire produced 102 progenies with 25.48±0.50 kg birth weight. Worst sire had 22% inferior birth weight of progenies as compared to best sire. Raja *et al.* (2010) and Hickson *et al.* (2015) also reported significant influence of sire on birth weight of progeny.

Heritability of birth weight in the present investigation was medium (0.24±0.08). Similar estimates of heritability (h^2= 0.21) was also reported by Kumar *et al.* (2008) in Frieswal (crossbred) cattle. Several other authors however reported higher estimate of heritability (h^2= 0.29) of birth weight in crossbred cattle (Mandal and Sachdeva 1999, Singh *et al.* 2011). Moderate heritability of birth weight reflects ample scope of improvement through managemental interventions.

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