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Genetic evaluation of black bengal goat for reproductive traits

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Abstract

This study aimed to evaluate the reproductive potentiality of Black Bengal goat. A total of 100 Black Bengal does were evaluated based on the recorded data that has been maintained under Black Bengal goat improvement program at Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. Investigation was done to ascertain the effect of generation, parity and season of birth of doe on birth weight (Bwt), age at first service (AFS), age at first kidding (AFK), average kidding interval (AKI) and average litter size per doe (ALS/doe).The mean Bwt, AFS, AFK, AKI and ALS/doe were 1.22±0.02 kg, 212.95±1.87 day, 360.26±1.88 day, 230.46±3.70 day and 1.53±0.03, respectively. Generation had non-significant ($p>0.05$) effect to all the respected traits. Parity and season of birth significantly ($p<0.001$) affected the ALS/doe. The litter size ranges 1.11 to 1.78, which increased linearly with the progressive parity of dam. Litter size (1.63±0.04) was found higher in summer, followed by winter (1.51±0.07) and rainy season (1.36±0.08). Estimated heritability for Bwt, AFS, AFK, AKI and ALS/doe were 0.46±0.12, 0.46±0.11, 0.49±0.11, 0.46±0.10 and 0.49±0.12, respectively. Though reproductive traits always have lower heritability estimates but all the estimates seem to have high magnitude. The range of estimated Breeding Value (EBV) of Bwt, AFS, AFK, AKI and ALS/doe versed over a wider context, which indicates there is scope for genetic improvement in next generation progeny except the Bwt trait. Altogether, the results of the investigated traits could be well used to select better candidates for producing next generation.

Key words: Black Bengal goat, Reproductive performance, Genetic evaluation, Estimated Breeding Value

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Introduction

Black Bengal goat (BBG) is the only goat breed of Bangladesh having great importance of high fertility, prolificacy, short kidding interval, delicate meat, adaptability to hot humid conditions, better resistance to common diseases and excellent skin quality (Amin *et al.*, 2001; Moniruzzaman *et al.*, 2002; Faruque and Khandoker 2007). Higher production performance of BBG may assure by systematic management and feeding that can lead profitable goat production of the country (Islam *et al.,* 2009). Animals are

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expected to be more productive at minimum cost, and effective in achieving local food security when they are genetically adapted to their own environment (Faruque *et al.*, 2010). Large variation exists between buck to buck and selection of superior breeding bucks with appropriate assisted reproductive technologies are necessary for the sustainable improvement and appropriate conservation of BBG (Khandoker *et al.*, 2011). Furthermore, about 50 percent of does are slaughtered each year to obtain meat for human consumption and other 20 % are culled due to several reproductive failures, results inadequate replacement of doe (Amin *et al.*, 2005). To exploit the genetic potential of BBG, genetic trend should be in upward motion. Growth rate of BBG can be improved through selective breeding program within the breed. While working with genetic improvement, collateral traits must be taken under consideration. Among the individuals, a large number of genetic variations exist in the traits of interest (Amin, 2000). Genetic improvement of a breed for growth traits can be achieved by utilizing these variations along with selective breeding program (Das, 2001; Akhter *et al.*, 2000 and Amin, 2006). Production potentiality of goat can be fully exploited when having a higher litter size with shorter generation interval as well as better fertility rate rather than other farm animals (Haque *et al.*, 2013). Considering these facts, this study is aimed to evaluate the reproductive potentiality and estimate the heritability and breeding value of reproductive traits of BBG doe under improvement program at BLRI.

Materials and Methods

Location and duration

Data on reproductive traits were collected from the record sheet that have been maintained at the Goat Research Farm, BLRI, Savar, Dhaka during the period of 2011-2017. A total of 100 BBG doe were evaluated with the recorded data under the Black Bengal goat improvement program.

Management and feeding of goats

Bucks and does were kept in separate houses to prevent unplanned breeding. Housing system was permanent house with slated floor raised around 4 feet upwards from the ground and adequate allocated space for their preferable comfort. Semi intensive management system was practiced. Six to eight hours grazing with 300g concentrate containing 17% CP and 11 MJ/Kg DM was supplied for each doe at 2 times in a day (morning and afternoon).

Breeding program

Selective breeding was conducted within the goat flock avoiding inbreeding as much as possible for both genetic and phenotypic improvement of respected traits. Selection on the flock was done by simple procedures mostly on assessed fertility with some attention to size, body conformation and condition to develop an elite Nucleus Breeding Flock (NBF). Every year ten percent female progenies are culled from the NBF. Animals were culled or selected on the basis of individual performance, pedigree and progeny performances.

Record keeping

Each goat was ear tagged to maintain the regular data recording. A total number of 100 does were evaluated with the information of six generations and five parities in the experiment. Reproductive parameters were recorded individually on each goat from the progressive generations. The weight of kids were recorded immediately after birth using a

digital weighing balance. Traits considered for the study were birth weight of doe (Bwt), age at first service (AFS), age at first kidding (AFK), average kidding interval (AKI) and average litter size per doe (ALS/doe). Three seasons were considered to describe seasonal effect viz. summer (March-June), rainy (July-October) and winter (November-February).

Statistical Model

Model-1: For descriptive statistics-

The model was applied for determining the effect of generation, parity and season of birth on Bwt, AFS, AFK, AKI and ALS/doe.

$Y^{ijkm} = \mu + G^i + P^j + S^k + e^{ijklm}$

Where,

Y^{ijkm} = Record of Y'th doe born in i'th generation under j'th parity in k'th season

μ = Population mean for any of the considered trait

G^i = Effect of i'th generation (where,i = 1st generation, 2nd generation, 3rd generation, 4th generation, 5th or more generation)

P^j = Effect of j'th parity (where j = 1st parity, 2nd parity, 3rd parity, 4th parity and 5th parity)

S^k = Effect of k'th season of birth, (where K=1, 2, 3)

e^{ijkm}= Random residual error

Model-2: Estimation of variance components and heritability-

The analyses have shown the variance components and heritability estimation using Restricted Maximum Likelihood (REML) approach. For REML analysis, animal model was used studying generation, parity, season and year of birth as fixed effects. The model was as follows:

$Y = X^b + Z^a + W^c + e$

Where,

Y = Vector of observations

X, Z and W = Known incidence matrices associated with levels of b, a and c with Y

b = Unknown vector of fixed effects (i. e. generation, parity etc.)

a = Unknown vector of breeding value

c = Unknown vector of permanent environment factors

e = Vector of residual effect

Statistical Analyses

Collected data for the study were firstly enrolled in Microsoft Excel worksheet and then further processing was done for final analysis. Statistical analyses were done using Statistical Package for Social Science (SPSS) software (IBM Corp., 2015) version 23. The differences between means were also analyzed by Duncan's New Multiple Range (DMRT) test in the same statistical package. Genetic evaluation, estimation of heritability and breeding value were estimated using Variance Component Estimation (VCE) version 4.2.5 (Groeneveld, 1998) and PEST (PEST UIUC V3.1) software.

Results

Birth weight (Bwt)

Birth weight always considered as primary selection standard for growth trend of animal (Singh *et al.*, 2000). Generation, parity and season of birth were found non-significant ($p>0.05$) on Bwt of BBG doe. Birth weight of does averaged at 1.22±0.02 kg which ranged from 0.95 to 1.25 kg (Table 1). Birth weight was found highest ($p>0.05$) in the kids of 1st and 5th generation (1.25±0.03, 1.25±0.09 kg). Highest Bwt was found in ≥5th parity (1.27±0.03 kg) and the lowest Bwt was showed by 3rd parity (1.11±0.04 kg). The does born in winter season had highest Bwt (1.29±0.04 kg) than the does born in

summer (1.20±0.03 kg) and rainy (1.17±0.04 kg) season.

Age at first service (AFS)

There was no significant effect (p>0.05) of generation, parity and season of birth on AFS of Black Bengal goat. The highest and lowest AFS (days) were observed in does of generation 4 (224.17±15.47) and generation 6 (205.50±1.50), respectively among the six generations with the average value of 212.95±1.87 days (Table 1).

Age at first kidding (AFK)

Table 1 shown that AFK increases consequently up to generation 4 and decreases in last two generations and AFK was non-significantly (p>0.05) affected by generation. Parity and season also found non-significant to AFK. The average AFK of this study was 360.26±1.88 days.

Average kidding interval (AKI)

Result showed no significant effect (p>0.05) of generation, parity and season on AKI. The AKI was 230.46±3.70 days which ranged from 177.75 to 318.3 days (Table 1). Kidding interval decreases with the progressive generations except generation 4 (237 days). The AKI in generation 6 was 194.00±0.00 days.

Average litter size per doe (ALS/doe)

Current findings found the average ALS/doe of Black Bengal doe as 1.53±0.03 which was not affected significantly (p>0.05) by generation but affected significantly (p<0.01) by parity and season of birth. ALS/doe of 6th generation was insignificantly (p>0.05) highest (1.75±0.25) and lowest average litter size (1.45±0.08) was seen in 2nd generation (Table 1). Significantly highest (p<0.01) ALS/doe was given by ≥5th parity doe's and 1st parity stood in lowest position. ALS was higher in doe born within summer season (1.63±0.04) and lowest in rainy season (1.36±0.08).

Estimation of heritability (h^2) for different traits

Table 2 shows that heritability estimates for all the reproductive traits of the study were high ranged from 0.46 to 0.49 although common principle is that h^2 for reproductive traits are low (0.10- 0.20) However, their corresponding high standard errors indicate less reliability. Reproductive traits always have lower heritability estimates for which genetic improvement is very slow.

Estimated Breeding value (EBV)

Breeding value (BV) estimation contemplates the actual genetic potential of transmitting ability of parents and the estimation for individual animals greatly depends on their performance or pedigree information after considering various environmental factors. The Estimated Breeding Value (EBV) of Bwt, AFS, AFK, AKI and ALS/doe ranged from -0.2830 to 0.3939, -12.3286 to 88.2578, -11.9900 to 77.4186, -40.9618 to 61.3396 and -0.46040 to 0.7668.

Discussion

The average Bwt of does was found 1.22±0.02 kg with a range of 0.95 to 1.25 kg. The birth weight of kid exactly agrees with the findings of Dhara *et al.* (2011). Lower birth weight in earlier studies ranged from 0. 89 to 1.2 kg (Akhter et al., 2000; Hossain *et al.*, 2004; Paul *et al.*, 2011; Mia, 2011; Halim *et* al., 2011; Mia *et al.,* 2013; Bhowmik e*t al.,* 2014; Haque, 2014; Ali, 2015; Miah *et al.*, 2016). Some findings found Bwt of Black Bengal kid as 1.60-1.86 kg which is quite higher than that of the current findings

Table 1. Productive and reproductive performance of BBG Doe affected by season, generation and parity

Factors	Least squares means (LSM)±SE for assorted traits				
	Birth weight (kg)	Age at first service (d)	Age at first kidding (d)	Average kidding interval of doe (d)	Average litter size per doe
Season of Birth-	NS	NS	NS	NS	***
Summer	1.20±0.03 (45)	208.93±1.05 (45)	356.11±1.05 (45)	229.78±4.49 (36)	1.63^{a}±0.04 36)
Rainy	1.17±0.04 (23)	218.87±5.79 (23)	366.22±5.79 (23)	243.32±9.24 (9)	1.36^{b}±0.08 (30)
Winter	1.29±0.04 (32)	214.34±3.76 (32)	361.81±3.78 (32)	225.90±7.88 (20)	1.51^{ab}±0.07 (15)
Generation	NS	NS	NS	NS	NS
1	1.25±0.03 (36)	208.64±1.21 (36)	355.92±1.22 (36)	236.85±5.27 (27)	1.55±0.06 (36)
2	1.24±0.04 (30)	215.73±3.37 (30)	362.97±.39 (30)	228.73±8.59 (13)	1.45±0.08 (30)
3	1.16±0.03 (15)	217.47±7.82 (15)	365.20±7.83 (15)	220.58±7.54 (12)	1.53±0.06 (15)
4	1.16±0.09 (6)	224.17±15.47 (6)	371.33±5.44 (6)	237.95±24.45 (4)	1.52±0.19 (6)
5	1.25±0.09 (11)	208.55±2.60 (11)	355.64±2.65 (11)	227.17±11.52 (8)	1.66±0.11 (11)
6	0.95±0.05 (2)	205.50±1.50 (2)	353.00±2.00 (2)	194.00±0.00 (1)	1.75±0.25 (2)
Parity-	NS	NS	NS	NS	***
1	1.20±0.06 (21)	209.57±1.27 (21)	356.90±1.28 (21)	-	1.11^{c}±0.06 (36)
2	1.26±0.07 (13)	221.15±7.38 (13)	368.00±7.42 (13)	-	1.43^{b}±0.09 (30)
3	1.11±0.04 (16)	213.38±7.30 (16)	360.75±7.35 (16)	221.40±5.89 (15)	1.60^{ab}±0.06 (15)
4	1.23±0.04 (20)	211.40±4.90 (20)	358.95±4.88 (20)	234.08±7.76 (20)	1.61^{ab}±0.08 (6)
≥5	1.27±0.03 (30)	212.57±1.70 (30)	359.87±1.76 (30)	232.58±5.39 (30)	1.78^{a}±0.04 (13)
Minimum	0.8	200	346	177.75	1
Maximum	1.9	321	469	318.3	2.5
Overall mean	1.22±0.02 (100)	212.95±1.87 (100)	360.26±1.88 (100)	230.46±3.70 (100)	1.53±0.03 (65)

Figure in the parenthesis indicate the number of observations. NS= Non significance ($p>0.05$), ***=$p<0.001$. a, b, c Means with different superscripts in the same column differ significantly ($p<0.05$).

Table 2. Estimates of additive genetic variance (o^2A), common environmental variance (o^2C), total phenotypic variance (o^2P) and heritability (h^2±SE) of reproductive traits of Black Bengal does

Reproductive traits	No. of records	Variance component			h^2 (x±SE)
		σ^2_A	σ^2_C	σ^2_P	
Birth weight (Bwt)	27	0.022	0.004	0.047	0.46±0.12
Age at first service (AFS)	27	189.151	26.638	411.19	0.46±0.11
Age at first kidding (AFK)	27	188.741	0.776	385.18	0.49±0.11
Average kidding interval (AKI)	25	429.482	56.67	933.65	0.46±0.10
Average litter size per doe (ALS/doe)	27	0.054	0.001	0.11	0.49±0.12

Where, A= additive genetic variance, C= common environmental variance, SE=error and P= phenotypic variance

(Hassan *et al.*, 2007; Hasan *et al.,* 2015). Chowdhury *et al.* (2002) found 1.24 kg birth weight for female Black Bengal kid where, generation, parity, season of birth and birth year were found non-significantly ($p>0.05$) affected the birth weight of kids. In another finding, Faruque *et al.* (2010) showed 1.28±0.11 kg birth weight in case of BBG kid which is close enough to this study. They also found female kids birth weight were not significantly ($p>0.05$) affected by generation, parity and interaction between generation and parity but only the male kid. Study conducted by different research group agree that birth weight mostly influenced by sex, type of birth, birth season and dam age (Supakorn and Pralomkarn 2009; Bharathidhasan *et al.*, 2009; Banerjee and Jana, 2010). However, higher birth weight is the indication of better nutrition, health and other management (Chowdhury *et. al.*, 2002).

In case of AFS, the average value was found 212.95±1.87 days that is similar to the result of Chowdhury and Faruque (2001) and that was 216± 9.52 days. Hasan *et al.* (2014) and Husain *et al.* (2004) found the AFS of BBG as 202.5±7.1, 208.82±12.60 and 209.00±32.25 days, respectively, which are quite less than the findings of the current study. Faruque *et al.* (2010) reported significant ($p<0.01$) influence of season and feeding level on AFS. The age at sexual maturity of BBG male and female were 228.35±2.12 and 237.83±4.31 days where, female goat gained sexual maturity earlier than male with significant ($p<0.05$) difference between them (Akhter, 2018). In another selective breeding program for reproductive traits reared under farmers' house, AFS were found as 249.63±15.57 and 241.68±11.45 days in first and second generations of BBG (Amin *et al.*, 2001) which is quite higher than the corresponding study. They also reported significant ($p<0.05$) difference between the goats of two generations where selected does attained sexual maturity earlier than the random bred Black Bengal does. Sexual maturity influenced by sex, activity of hormone, evolvement of reproductive

Table 3. Estimated breeding value of Birth weight of kids (Bwt), age at first service (AFS), age at first kidding (AFK), average kidding interval (AKI) and average litter size per doe (ALS)

Generation	Animal ID	Bwt	Rank	AFS	Rank	AFK	Rank	AKI	Rank	ALS	Rank
	3011	-0.1138	9	0.6181	10	1.1583	11	-17.9778	3	0.3873	2
	3019	-0.1984	10	11.5731	3	9.0473	12	-26.5471	1	-0.0979	9
	3040	0.3093	1	-3.3655	8	-1.4714	9	-5.8748	5	-0.0979	10
	3041	0.1401	2	0.6181	11	0.2871	10	16.0343	12	0.0587	6
	3076	0.0554	4	3.3655	12	-2.3479	8	-20.1422	2	0.1863	5
	3107	-0.1984	11	-9.3409	6	-6.7307	5	-3.4159	7	-0.363	11
1	3202	0.0554	5	-5.3573	7	-4.9776	6	8.1276	9	-0.0606	8
	3315	-.1984	12	-12.3286	1	-9.3604	3	16.2110	11	-0.4566	13
	3348	0.0554	6	-11.3327	2	-11.9900	1	11.8380	10	0.2168	4
	3366	0.1401	3	-2.3696	9	-2.3479	7	61.3396	13	0.7668	1
	3413	-.1984	13	-10.3368	5	-9.3604	2	-7.6417	4	0.0185	7
	3425	-0.0292	7	-11.3327	4	-8.4838	4	-5.6098	6	0.2759	3
	3473	-0.0292	8	8.5854	13	-		2.7386	8	-0.4604	12
	2987	0.3939	1	-0.3778	5	-2.3479	5	-4.5497	4	0.2261	1
	3001	-0.1984	7	-10.3368	1	-9.3604	1	50.2231	9	0.1299	2
	3210	-0.1984	8	-7.3491	4	-5.8541	4	-35.2195	1	-0.0564	7
	3233	-0.1138	5	25.5158	9	23.9487	9	11.0723	7	0.1063	3
2	3341	-0.1984	9	88.2578	10	77.4186	10	-2.5920	5	-0.4566	9
	3364	0.0554	3	6.5936	8	7.2942	8	7.1852	6	-0.3153	8
	3429	-0.1138	6	2.6100	7	2.0349	7	12.1472	8	-0.0522	5
	3438	0.2247	2	-8.3450	3	-6.7307	3	-14.2674	3	0.0185	4
	3449	-0.0292	4	0.6181	6	0.2817	6	-21.7766	2	-0.0522	6
	3451	-0.2830	10	-9.3409	2	-8.4838	2	-		-	
	3009	-0.1984	2	-4.3614	3	-2.3479	3	-9.7619	2	-0.0979	2
3	3381	-0.1138	1	-8.3450	1	-6.7307	1	-40.9618	1	0.0185	1
	3447	-0.1984	3	-5.3573	2	-4.1010	2	-		-	
4	3015	0.1401	1	-5.3573	1	-4.9776	1	-7.20	2	0.1299	1
5	3321	-0.1138	2	-5.3573	2	-2.3479	1	42.1838	3	0.6879	1
	3403	0.0554	1	-11.3327	1	11.1135	2	-15.5926	1	-0.1701	2

organ, photoperiod and nutritional state of goat. The variations among the findings of the different researchers within same genotype could be due to any of those reasons or combination effect.

The average AFK of this study was 360.26±1.88 days which exactly agreeable with the result of Hassan *et al.* (2007). Faruque *et al.* (2010) found lower kidding interval of BBG in intensive rearing system (283.83±31.16 days) rather than semi intensive rearing system (370.26±25.48days) which is quite higher than the current findings. Hasan *et al.* (2014) reported AFK of BBG was 448-450 days and significantly affected by parity ($p<0.05$) and generation ($p<0.01$) which is much higher than the current result. The change in age at first kidding occurs for partly environmental or genetic reason. Therefore, lower AFK reduces the rearing cost, increases economic returns, also facilitate highly desirable rapid genetic progress (Devendra and Burns, 1983). Variations of AFK within the same genotype might be due to difference in environment, management and feeding in which goats were kept.

The average AKI was found 230.46±3.70 days which ranged from 177.75 to 318.3 days. The findings are close to 220.55±2.88 days found by Husain *et al.* (1993). The kidding interval was quite higher than the previous finding period of 177–192 days (Chowdhury *et al.*, 2002), 193.10 days (Hossain *et al.*, 2004), 179.0 ± 20 days (Hassan *et al.*, 2007), 198.0 days (Miah and Alim., 2009), 181.76 days (Bhowmik *et al.*, 2014), 190.2 days (Hasan *et al.*, 2015), 188.01 days (Jalil *et al.*, 2016), 186.15 days (Miah *et al.*, 2016) and 176.86 days (Talukder *et al.*, 2016; Moni and Samad, 2019). However, much longer period of 252.45 (Halim *et al.*, 2011) and 302.5±4.55 (Haque *et al.*, 2013) days kidding interval has also been reported. Amin *et al.* (2001) found AKI of BBG does as 255.32±19.29 and 211.62±11.62 days, respectively in 1st and 2nd generation. Nonetheless, Faruque *et al.* (2010) did not find any significant influence of generation on this trait. Kunbhar *et al.* (2016) reported postpartum period was mostly affected by nutritional management, suckling by kid, parity, kidding status and breed. The variations of kidding interval with wide range among the research groups within same genotype might be due to different management system, type of feeding, reproductive management, seasonal variation, shortage of breeding bucks or diseased condition. Other than non-genetic factors, selection of superior parents with progressive generations might play significant influence on this trait. Less time for kidding interval of BBG doe allows it to indicate the absolute seasonality of estrous occurrence which results kidding twice in a year (Husain, 1993).

The average ALS/doe of Black Bengal doe was found 1.53±0.03 which is alike with the results of Choudhury *et al.*, 2002 (1.58±0.09); Paul, 2012 (1.56); Mia, 2011(1.5); Khan and Khatun, 2013 (1.50); Hasan *et al*., 2015 (1.06); Mahfuz *et al.,* 2018 (1.5±0.1). The litter size significantly ($p<0.01$) increased with the progressive parity (Chowdhury *et al.*, 2002; Paul *et al.*, 2014). The ALS per doe of this research was found much lower than the reported litter size of 2.0 (Hossain *et al.*, 2004; Akhter *et al.,* 2006; Islam *et al.*, 2009), 1.68±0.001 (Halim *et al.*, 2011), 2.61 (Rume *et al.*, 2011), 1.81±0.1 (Ali, 2015), 2.13±0.102 (Miah *et al.*, 2016), 1.75 (Jalil *et al.*, 2016) and 1.76±0.08 (Solaiman *et al.*, 2020). Faruque *et al.* (2010) reported that litter size

was significantly ($p<0.001$) affected by rearing system and season of birth and average litter size was 1.94±0.06. Nutritional status, body weight, parity, age of dam and genetic factors has impact on litter size (Tudu *et al.*, 2017). Litter size can be varied as a result of the interaction between genetics and environment, dam age, parity and non-genetic factors.

Reproductive traits of goats are considered as for low heritability value and improvement in reproductive potentiality of goat flock by means of genetic selection tends to slow and sometimes almost impossible, though genetic potentiality of a goat flock is very important (Husain, 2004). The magnitude of heritability estimates for Bwt, AFS, AFK, AKI and ALS/doe were high which indicates that the trait has high transmitting ability and, therefore, will result in high selection response in selection program. The heritability (h^2) estimates for all the reproductive traits of the current findings were invented high. This result might be as an outcome of using small sample size, within population variance for a trait and methods used in the experiment. Many authors found low heritability estimates (Mia *et al.*, 2013; Vatankhah and Salehi, 2010; Bagnicka *et al.*, 2007) for reproductive traits. Faruque *et al.* (2010) studied heritability 0.15±0.18 for, litter size which is very much lower compared to the present study. Haque *et al.* (2013) found the heritability estimates for age at first kidding, litter size, post-partum heat period and kidding interval as 0.21±0.11, 0.14±0.12, 0.24±0.14 and 0.17±0.11, respectively and the values are low to medium in magnitude. For the trait birth weight, estimated breeding values (EBV) of Black Bengal bucks was ranged -0.0423 to +0.0278 (Mahal *et al.*, 2012) but no such available information for does which is much lower than the current findings (-0.2830 to 0.3939). All the considered traits showed wider range of genetic variations indicates high scope for genetic improvement. On the other hand, the trait Bwt results small range in EBV indicates less variation and less scope for genetic improvement. BVs were measured for individual trait. So, considering single trait for genetic improvement the best individual that ranks first in terms of BV could be selected. But in case of multiple traits at a time, it will require to combine the genetic merit (BV) of animals. This can be accomplished by constructing multi-trait selection index. However, the more the traits considered at a time for selection the lesser is the efficiency.

Conclusion

All the reproductive traits found to be improved in generation 6, but the improvement trend did not follow any significant direction with the progressive generations. Though reproductive traits always have lower heritability estimates, but all the estimates of the findings seem to have high magnitude. According to the Estimated Breeding Value, does bearing ID number 3315, 3348, 3381, 3366 and 2987 ranked best doe for the traits of birth weight, age at first service, age at first kidding, average kidding interval and average litter size per doe, respectively. The estimated breeding values of the traits suggested that the result could be well used to select candidate doe's for producing next generation in the selection program. In order to obtain more reliable results on these parameters, further research with larger sample size needs to be conducted.

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